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ABSTRACT

The study determined the acceptance by high school students of a mobile-classroom approach to the teaching of electronics. Also investigated was the effectiveness of this teaching method with high school students in the southern Utah communities of Milford, Beaver, Delta, and Fillmore during the 1968-69 school year. As ascertained by the attitude inventory scale, the program unit was well accepted by the students. In addition, student improvement was made in relation to the knowledge of electronics during the course period. The mobile unit was viewed as a possible partial solution to the problem of the small high school which, with its limited faculty and funding, has to compete with the larger schools in producing students with salable skills for the job market. Advantages, disadvantages, and recommendations regarding the use of the mobile classroom were discussed. (ED)

# A STUDY TO DETERMINE THE ACCEPTANCE AND EFFECTIVENESS OF AN EXPERIMENTAL MOBILE UNIT WHICH SERVES MILFORD, BEAVER, DELTA, AND FILLMORE IN SOUTHERN UTAH

OFFICE OF THE STATE SUPERINTENDENT OF PUBLIC INSTRUCTION

Produced by the Utah Research Coordinating Unit
for Vocational and Technical Education

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## SUMMARY

The idea of mobilization is a relatively modern conception in education. This study was designed to determine the acceptance and effectiveness of an experimental electronics mobile unit which served four Southern Utah high schools during the 1968-69 school year.

The review of literature which was studied gave examples of various types of mobile units in use at the time of the study. The review includes ideas which have been experimented with on organizational methods and versatility of subject areas. From the review of literature was extracted the attitude and aptitude tests which were used in this study.

Correspondence took place with the Utah State Department of Education, Southern Utah State College, and persons outside of Utah who have had experience with mobile programs.

With reference to the student objectives which were set up, the data brought out the student attitudes and evaluated the student improvements. This was accomplished through the use of an attitude inventory scale and the pre-test and post-test method. From the student questionnaires, information on student selection and stimulated interest in the area of electronics was ascertained.

Through a detailed study of the program, the curriculum objectives were discovered. These objectives include whether or not the six week period of instruction was sufficient and if the mobile unit could stand as the total electronics program.

Using the State Guide for Industrial Arts as a medium of comparison, the differences in the curriculum covered, and that of the State Guide

were determined. The State Guide gives an outline for a 36 week program in the first level of electronics. According to the outline of the mobile program, (refer to pages 17-18 of this report) more information was attempted to be covered during this six week period than the State Guide lists in the 36 week program.

In the Eighth Annual Industrial Arts Yearbook, information relating to the adequate sizes of electronics laboratories is given. This source states that a minimum of 75 square feet is the required working area for each student. One hundred square feet is the adequate footage, and 125 square feet are desired. The mobile unit being studied is approximately 360 square feet totaled. Using the above standard the mobile unit would provide the minimum amount of space for four students at one time plus enough space for storage.

Correlations were illustrated through the use of a chart between the success of the students in the electronics program and their previous mathematics experience and GATB percentiles.

The attitudes and opinions of the program instructor were shown through a personal interview with him.

## CONCLUSIONS

Based on the findings of this study, several conclusions have been reached.

1. An improvement was made in relation to the knowledge of electronics during the course period. This is demonstrated by the fact that the overall gain was significant at the one percent level.

2. The program unit was well-accepted by high school students. This was illustrated by the positive attitudes given in the attitude inventory scale.

3. A correlation can be made between a student's mathematics experience and his success in electronics.

4. Students living in rural areas in Southern Utah show enough interest in electronics to efficiently utilize a program of this type.

5. The amateur radio included in the van served as a learning device and created much interest among the students.

6. The space provided in the mobile van is not sufficient for the number of students enrolled.

## RECOMMENDATIONS

In view of the preceding information which has been brought forth and the conclusions made, it is advocated that this mobile electronics program be continued with the following recommendations:

1. A follow-up study should be made to determine the rise or drop in registration for this course during the 1969-70 school year.

2. A further study could be made to determine the number of students who are actually influenced into going into some occupational phase of electronics.

3. The following items should be considered in relation to the physical unit itself: (a) Future units should be expanded to at least a greater width to allow more work room for the students, and (b) improved air conditioning facilities would improve the working atmosphere of the class.

4. A longer stay at each school should be put into effect.

5. Steps should be taken to see if separate high school credit in electronics could be given for participation in this class.

6. A text and lab book should be determined for use as a guide and review in this class.

7. A screening of students should be made prior to the school year for determining class levels to aid in differentiating the speed of information given in varying classes.

8. Rather than making up a separate outline of material to be covered, consideration should be given to the Utah State Guide as a course of instruction.

# CHAPTER I

# INTRODUCTION

Industrial educators are interested in experimenting with modern types and techniques of teaching. Small high schools, because of low student numbers and insufficient funds usually do not have the facilities to operate all programs. Therefore, the opportunities which the small high school affords are not up to the standard of those from a larger high school. Yet they have to compete with the students from the larger high schools for jobs. In the area of electronics, this is also evident. Because of the opportunities which industry offers, trained personnel are relatively difficult to obtain.

A solution to this problem might be found by bringing a mobile electronics unit into the areas of small high schools. If a project of this type proved successful, it would hold promise for each rural school faced with the growing need to offer vocational education attuned to today's technology, but lacking the funds, facilities, and staff to operate programs completely on its own (32).

## Statement of the problem

The purpose of this study was to determine the acceptance and evaluate the success of an experimental mobile electronics unit which has been developed to serve certain small high schools in Milford, Beaver, Delta, and Fillmore in Southern Utah. Specifically, it has attempted to answer the following questions:

Students:

1. What gains are evident through the pre-test and post-test?

2. What attitudes are brought out through the attitude test scale?

3. What criteria was used in making student selection?

4. Has this program stimulated a student interest in the field of electronics?

Curriculum:

1. Does a six-week period give sufficient time, or would a longer program be more adequate?

2. Is the program better suited for being the total electronics program or for complementing a basic full year course?

3. Using the State Guide as a medium of comparison, how does the curriculum of the mobile unit compare?

Unit:

1. Does the trailer unit meet the necessary requirements in regard to size, equipment, convenience of mobility, and necessary physical facilities?

2. How does the schedule fit the utilization of the facilities for maximum efficiency in regard to the use of time?

3. Can the project be realistically funded?

## Importance of the study

Vocational training in electronics is becoming increasingly important in our society. Electronics is present in almost every imaginable field of development. We are always hearing of new discoveries and developments which seemed almost impossible only a decade ago. Electronics plays a part in all of these.

> The laser beam which sounded like science-fiction a few years ago, now burns holes through steel, detects art frauds, and promises to illuminate the ocean depths and revolutionize surgery. Color TV, once a novelty, now out-sells black and white, and the industry talks about wall-sized, 3-dimensional images. We have quickly accepted the miracle of world-wide TV transmission through communications satellites and now watch European sports events with a sense of novelty. (29, p. 7 )

It is impossible to stand still in the middle of all of this. The rest of the world moves ahead, and if we do not move with it, we are really moving backwards. The only way we can keep up is through additional training.

A mobile classroom which is equipped with modern electronics equipment may help fill the need for this additional training. ~~This will give~~ students an opportunity to work with equipment which they, otherwise, would not be exposed to.

This will prepare them at an earlier age for the increasing demands of electronics occupations.

Definitions of terms used

For purposes of this study, definitions of common terms used will be as follows:

Mobile Classroom - A mobile classroom in a mobile home shell with the interior arranged and decorated like a classroom that... "is capable of moving or being moved." (35, p. 320)

Small High School - High schools with grades 9-12 having an enrollment of less than 300 students are classified as small high schools.

Large High School - High schools with grades 9-12 having an enrollment of more than 300 students are classified as large high schools.

Attitude - "A kind of mental set representing a predisposition to form certain opinions. Or--a frame of reference that influences the individual's views or opinions on various topics, and that influences his behavior." (24, p. 52 )

## Delimitations

The mobile electronics classroom will be at four different locations for a period of approximately six weeks at each location. These areas include the Beaver School District, Milford High School, and Beaver High School. Then also Delta and Millard High Schools in the Millard School District.

Only these four schools will be studied in this descriptive study.

For this study, it is recognized that initially the evaluation will be quite subjective in nature and that many tentative "indicators" will have to be used as measures of effectiveness. Eventually, the careers of the students will be followed for a few years after leaving school to note any differences between their success and the successes of those from other classes, schools, or electronics programs. Every attempt will be made, however, to use objective measurements and judgements whenever possible.

This study will be limited to small high schools in Utah and evening adult classes. No attempt will be made to present the program to large high schools or junior high schools, or schools outside the state of Utah. The study will not be completely objective. Some of the measures will have to be subjective in nature.

Since the project was already underway before the author could set up test measurement procedures and materials, the pre-test and post-test was not used at Milford High School.

## Methods of procedure

A review of literature gives the foundation necessary for carrying out the steps of procedure. A thorough review of the literature available has been made and extensive material has been collected.

As the study moved along, a collection of the data was kept. This collection includes any test given, questionnaires, and any correspondence which has taken place.

A test, developed by Todd Hamilton Herring of the University of Illinois, was used for the pre-test and post-test (16). The test covers the basic facts of an electronics course. This examination was given at each school except Milford High School at the beginning of the course. The same test was given again at the end of the six weeks as a means of evaluating student improvement.

Following the post-test on the last day of class, an attitude test was administered to each enrolled student available (13). The purpose of this test was to discover student feelings in connection with the course.

A questionnaire, which was prepared to obtain student opinions and evaluations not included in the other two tests, was mailed to each student for an anonymous reply containing their ideas.

The instructor of the unit was asked to voice his opinions for consideration, and information was sought out from experts who have had experience with mobile classrooms. Close contact was maintained with the sponsors of the mobile electronics unit.

A careful evaluation was made on certain records relating to the program involved. Several state records were studied for standards which were to be met as far as the physical environment was concerned. Student records were studied for statistical purposes.

# CHAPTER II

## REVIEW OF THE LITERATURE

Communities across the nation and even throughout the world are discovering that students do not have to be taken to an educational facility for learning activities; the facility can be taken to them (2). Classrooms on wheels have been in existence since the 1930's. They appear to have had their first introductions through a Canadian educational project because of the large numbers of children of trappers, lumbermen, and railwaymen who lived too far from the nearest schoolhouse to have the advantages of an education (18). These classrooms were, and in some cases still are, converted railway coaches which hitch on behind a freight train and travel to many tiny settlements where they are unhitched for various periods of time (8). These are the only schools which are available to serve some areas, and the progress of the students involved is often more rapid than that of students in the more populated areas where they attend conventional schools (18). This suprising fact has been carried over into other mobile units. School officials involved with a mobile program in many areas have reported heightened motivation among students. They are intensely fascinated with the idea and are motivated to learn (2).

Today mobile vehicles are serving numerous students. The use of these vehicles is fulfilling varied needs. For example, some school areas use the mobile units to take care of overflow students. The mobile classroom costs only about half as much as a permanent classroom, and they can be pulled into a specific location very easily on a temporary

basis (12). In one area of Missouri, a school was demolished by a tornado. Stripped railroad cars were converted into classrooms until a new school could be built (21).

The education facility on wheels is meeting not only the needs of local school districts but colleges and universities have learned the values of having educational facilities on wheels as time and need dictates (2). Because of the enlarging enrollment, a college in Oregon has converted its major areas into temporary mobile units while the campus can be basically remodeled. The library, cafeteria, student union building, and many departments are located in large mobile areas (26).

Another need which may be fulfilled through a mobile unit is that of providing experiences for the students in rural areas. Operating funds are not available to these areas to provide up-to-date spaces like science laboratories or audio-visual centers. Where enrollment is relatively small, money is not available for buying much of the equipment which is provided by large urban areas. In some areas several small schools, through cooperation with each other, are able to hire specialists in certain areas and provide for mobile equipped units which can travel from school to school at the benefit of everyone (15). This is similar to the need of the schools which are contained in this study. These particular traveling classrooms are really made to be moved. They are not like the portable classrooms which are only portable in the sense that they have wheels and are moved to a site where they become an almost permanent installation (4).

Mobile learning vehicles are available in almost any size. They range from renovated school buses (3), to station wagons (6), trucks (5), railway cars (21), or large mobile homes (25).

Nearly any type of instruction is conducive to mobilization. The mobile library has been available for several years and is, perhaps, the most common (36). However, in recent years, the "bookmobile" has been enlarged into a mobile media center (9). Funds from the Elementary and Secondary Education Act Title I have made possible the purchases of many modern audio-visual inventions (5). These centers now provide equipment to aid teachers in preparing for their classrooms with films, transparencies, projectors, and many other pieces of equipment. The hiring of certified librarians and teacher assistants to operate the mobile learning center has also been made possible (25). One place where the instructional media center has been very helpful is in the vast areas of Alaska (19). The teachers are encouraged to visit the mobile lab along with the students, because both can benefit greatly from taking advantage of the research center (9).

Other examples of mobile classrooms which have been experimented with include driver education, health, swimming (17), science (6), programmed reading (27), remedial reading (14), reading clinics (7), special education (31), business (15), and even traveling bookstores (23).

A "computmobile" carrying computers is becoming a popular classroom unit in the Pacific Northwest (10).

The area of guidance and counseling is utilizing mobilization (34). Through this program, automatic data processing equipment, test scoring machines, and other pieces of time-saving equipment can be installed for use in several schools. In this way counselors have time to work individually with students (37).

Several successful attempts have been made to put religion on "wheels". One church in the New Mexico area has sent a four-wheel drive unit containing

a church altar and living quarters for a minister to the Navajo Indian Reservation (11).

In New York City a specially equipped mobile language laboratory is bringing the latest in electronic classroom facilities to Puerto Rican adults in an effort to help upgrade their employment opportunities by improving their command of the English language (3).

Several experiments have been carried out involving mobile industrial arts classes. The first of these projects to use Title III funds took place in California. The organization of the program included four industrial arts learning laboratories, each one placed at a different junior high school. The laboratory was 37 by 50 feet and contained a 10 by 50 foot removable section of floor. The stationary section contained equipment which is common to any phase of industrial arts, while each of the four removable sections contained equipment related to one specific area of industrial arts. Each removable section would rotate to a junior high school for a nine-week period enabling the students to experience four separate industrial arts programs, each carried on in a unit shop designed for that purpose. The four phases which were conducted in this particular project were electricity, power mechanics, graphic arts, and metals. Study shows that the cost of facilities and equipment of this type of plan is reduced to about 20 percent of that of permanent unit shop facilities (33).

In another area of California, several large Navy ordinance trucks travel 400 miles from school to school carrying industrial arts equipment. More and more schools are participating as additional shop units can be added (22).

A power mechanics workshop unit is very successful in one area of California. It contains jig saws, grinders, jointers, lathes, disks,

drill presses, a circular saw, and a sander. This equipment fits easily on the converted bus and leaves ample space around each work station for the eight students who can work in the bus at one time (30).

If a mobile is to be scheduled on a school by school basis, arrangements must be made for proper parking stations, proximity to power and utility connections, and convenience in moving from one location to another (20).

The articles researched pointed out that the amount of money spent on a mobile unit can be varied greatly. With the help of local service clubs, one school district in Vermont remodeled an old school bus which was donated to them and made a complete remedial reading classroom with just $500 (1). Other units may spend thousands of dollars in using high trailer units and adding many luxuries. Of course, the size and cost of the vehicle does depend a great deal on the basic purpose for which it will be used. In most of the examples given in the literature reviewed, the mobile vehicles were equipped with carpet, chalkboards, individual work areas or desks, a heating unit, fluorescent lighting, audio-visual equipment, and an electrical outlet to plug into a central source of electricity at each location. Some units were described as being more elaborate with such items included as large bulletin boards, display areas, vast amounts of storage areas, and restrooms (36).

Concerning how to acquire a mobile vehicle in the first place, in one of the articles researched, the writer listed the most common means of obtaining a unit. These are as follows:

1. The outright purchase of a new or used vehicle.
2. The conversion of an old school bus, home trailer, or truck.
3. The leasing or renting of a mobile unit which is already equipped (31).

Much of the organizational development of separate units varied greatly. The amount of area covered in traveling from one school location to another depended a great deal on the physical area. The regularity of visits or length of stay differed among the programs between very short visits, even as short as one to two hours, to extended visits, up to becoming an almost permanent part of the school curriculum.

The advantages of using mobile units for commercial uses are important. Industry uses them widely in sales demonstrations and exhibits. Through this method, they are able to take their ideas along with a feeling of personal relationship to many people. According to one managing director of a national association, the mobile unit "represents one of the best investments in public enlightenment to be cooperatively undertaken by industry." (28, p. 130)

Many of the advantages of a mobile learning program are obvious. It is a relatively new educational concept, but studies prove its value and success. Many workers who are actively involved in the programs are excited about them. For example, the coordinator of a mobile electronics training program in New Mexico has stated:

> If it succeeds on a pilot basis, this approach holds promise for every rural school faced with the growing need to offer vocational education attuned to today's technology but lacking the funds, facilities, and staff to operate programs wholly on its own. (32, p. 42)

This statement related closely to the facets of the study of the mobile electronics unit in this particular thesis.

# CHAPTER III

# PRESENTATION OF DATA

## Introduction

The purpose of this section is to bring forth the results which have been determined concerning the acceptance and effectiveness of the mobile unit. It will include the organization and physical set-up of the mobile unit, all of the statistical information which has been established, the attitudes of the students involved in the program, and the correlations which have been discovered between this particular electronics course and the backgrounds of the students.

The attitudes and opinions of the instructor of the course will be referred to in the section of information relating to the unit itself.

## Sources of data

Since one of the main objectives of this study was to determine the effectiveness of the entire mobile unit, the 84 students participating in this program were the primary source of data. Through the pre-test and post-test method of procedure, it became possible to determine whether or not an increase in electronics proficiency occurred.

To determine the acceptance of the mobile unit, an attitude inventory scale was administered to each enrolled student at the conclusion of the course.

Another source of data was the personal student records at the high schools involved.

The final and very important sources for information were the Utah State Department of Education, Southern Utah State College, and Mr. Ken Mumford,

the course instructor. From these sources, information was received concerning the physical facilities of the unit and many other important details and facets of the program.

Information relating to the unit

The mobile vehicle which was used in this program is a converted mobile home. Its dimensions are approximately 8 x 45 feet. It was obtained from surplus for the sum of $100, and extensive repair work was required to put it into a useful condition (refer to Figure 1). The interior of the vehicle is fully carpeted and heated with electricity. Two small air conditioners are included. It contains flourescent lighting and work areas for 14 students at one time (refer to Figure 2). Each of the seven student work benches contains an oscilloscope, VOM, and signal generator, along with other various small items. Four drawers are provided in each area. The back width of the vehicle holds three closet and shelf areas for storage and one air conditioner (refer to Figure 3). The front area includes a chalkboard with storage area behind and below it. In this area is stored the overhead projector and other audio-visual equipment. One work area at the front of the unit is used for the instructor's desk. It also holds the amateur radio equipment. One wall holds a small bulletin board (refer to Figure 3).

At all four of the areas, the unit was located very close to the high school. A central hook-up was easily managed.

In the original planning, it was decided that the unit would spend six weeks at each school. This was carried out at Milford and Beaver. However, at Millard High School in Fillmore and Delta High School, the van only stayed for five week periods because this was all the time that was allowed before the conclusion of school. Also included in the

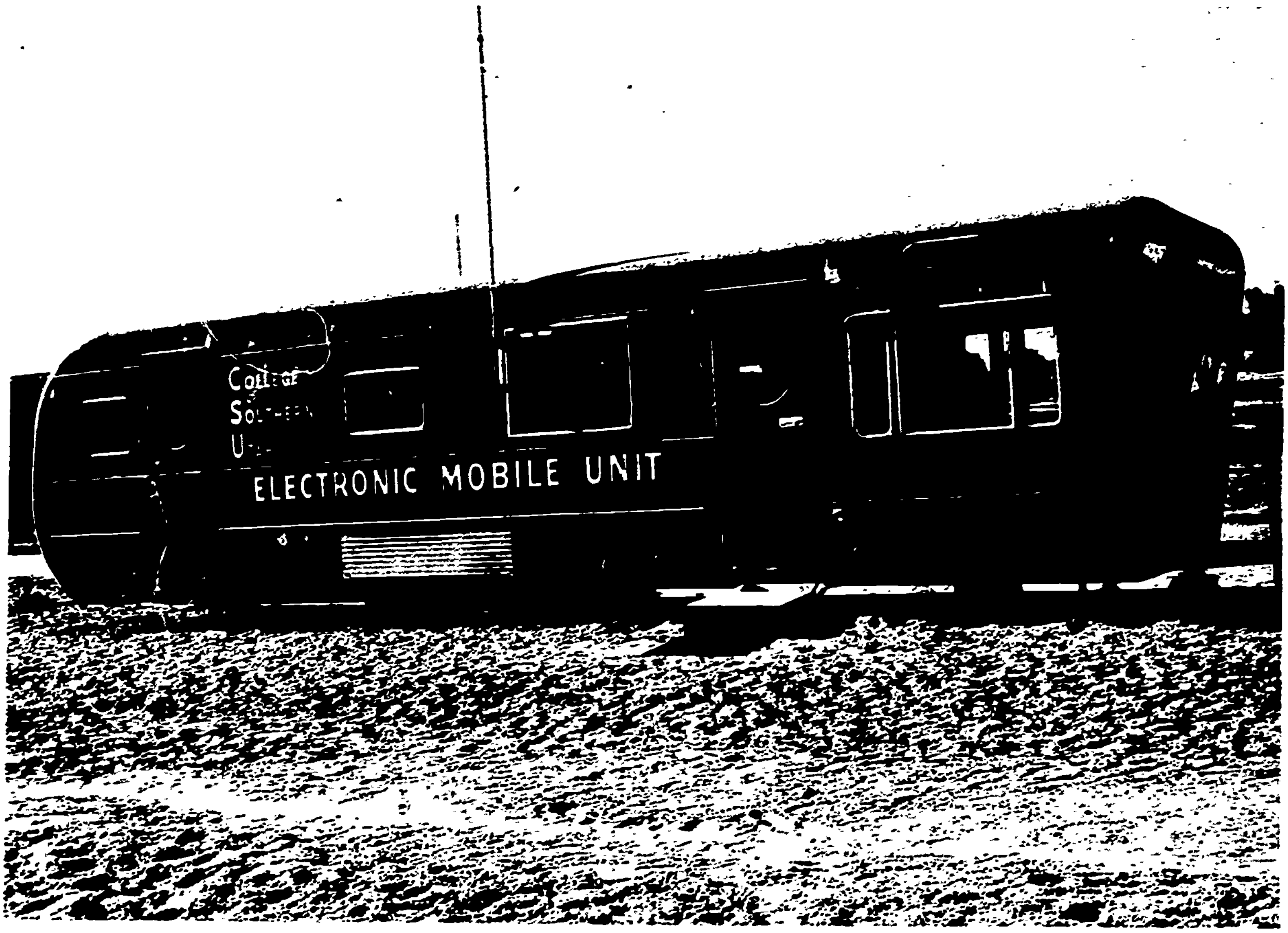


Figure 1. Exterior view of mobile unit.

Figure 2. Interior view of mobile unit.

Figure 3. Interior view of mobile unit.

original planning or organization was a basic outline of topics to be discussed during the instruction periods and lab experimentations. The instruction period outline included six topics with several subtopics listed under each topic. The topics are as follows:

1. <u>Electricity</u>
   A. Molecular Structure
   B. Charges
   C. Electrostatics
   D. Magnetism

2. <u>D.C. Circuits</u>
   A. Voltage
   B. Current Flow
   C. Resistance
   D. Ohms Law
   E. Power Relationships
   F. Series Circuits
   G. Parallel Circuits
   H. Combined Circuits
   I. D. C. Generators
   J. D. C. Motors

3. <u>A.C. Circuits</u>
   A. Inductance
   B. Capacitance
   C. Phase Relationships
   D. Resonant Circuits
   E. A.C. Generators
   F. A.C. Motors
   G. A.C. Distribution System

4. <u>Circuit Applications</u>
   A. Diode Transistor and Vacuum Tube Principles
   B. Power Supplies
   C. Amplifiers
   D. Oscillators
   E. Audio Circuits

5. <u>Radio and Television Receivers</u>
   A. Amplitude Modulation - Antennaes
   B. Tuners
   C. Superhetrodine
   D. Frequency Modulation
   E. Detectors
   F. Discriminators
   G. Frequency Allocations
   H. UHF-TV
   I. VHF-TV
   J. Scanning
   K. Electron Guns

6. <u>Transmitters and Industrial Electronics</u>
   A. Radio
   B. Television
   C. Communications
   D. Industrial Control
   E. Electronic Heating
   F. Computers

The lab experimentation outline included six topics also along with several subtopics. These topics are as follows:

1. <u>Electricity</u>
   A. Charges, Electrostatics
   B. Magnetism

2. <u>D.C. Circuits</u>
   A. Use of Meters and Test Equipment
   B. Resistance, Voltage, and Current Relationships
   C. Series, Parallel, and Combined Circuits

3. <u>A.C. Circuits</u>
   A. Inductance
   B. Capacitance
   C. Resonant Circuits

4. <u>Circuit Applications</u>

   A. Power Supplies
   B. Amplifiers
   C. Oscillators

5. <u>Receiver Circuits</u>
   A. Tuned Circuits and Detectors
   B. Radio Receivers
   C. Television Receivers

6. <u>Transmitters and Industrial Control</u>
   A. Radio Transmitters
   B. Modulation
   C. Control Circuits

Since the vehicle was relatively small, mobility was not a major problem. Prior to relocation, Mr. Mumford, the instructor, would set all of the equipment on the floor and lay all of the work stools down into a stationary position. The moving process would take place during the weekends.

While at Milford and Beaver High Schools, Mr. Mumford worked as a student teacher and kept close contact with the regular industrial arts

teacher in the schools. Just one class was held each day. At Fillmore and Delta, however, his salary came from the school district. Under this situation, Mr. Mumford taught several periods each day. The periods were made up of two-hour blocks, so the lab facilities were used to a maximum efficiency.

During a personal interview with the instructor, Mr. Mumford brought forth many of his personal opinions relating to the physical conditions of the van. A copy of this interview is located in the appendix of this thesis.

Results of pre-test and post-test

An examination covering basic electronic facts was given at the beginning of the course at each school except Milford, as explained in the delimitations. Of the 84 enrolled students, 66 were given this examination. The same test was given again to the same students at the end of the course. The purpose of this test was to provide a means of evaluating student improvement during the time spent in this program.

The test which was administered was taken from a study by Todd Hamilton Herring, Ed.D., of the University of Illinois. The purpose of his study, which was taken in 1962, was to develop and try out a test of knowledge of electricity and electronics at the junior high school level. During his study the multiple choice test was refined, developed, and shortened by analyzing the results obtained through a pilot study. It was determined that this test form was ready to be used in further studies (16).

Table 1 on the following page summarized the results which were obtained from the pre-test and post-test. It illustrates that, by individual school listings, all of the schools tested showed significant

improvement except Beaver High School. In this high school an improvement was shown, but it was not great enough to reach the significant level. An evaluation of the total students involved demonstrates that the t-ratio is 3.35 which is significant at the 1 percent level. The total significance illustrates a definite marked improvement between the pre-test and post-test.

Table 1. Ratio of the means between pre-test and post-test

| School | N | M | SD | σM | σDiff | t | % |
|---|---|---|---|---|---|---|---|
| Beaver High School | | | | | | | |
| Pre-test | 11 | 44.36 | 8.13 | 2.57 | | | |
| Post-test | 11 | 49.55 | 9.89 | 3.13 | 4.03 | 1.28 | no sig. |
| Millard High School | | | | | | | |
| Pre-test | 24 | 37.00 | 16.1 | 3.35 | | | |
| Post-test | 24 | 46.80 | 14.4 | 3.00 | 4.5 | 2.18 | 5 |
| Delta High School | | | | | | | |
| Pre-test | 31 | 42.00 | 12.25 | 2.24 | | | |
| Post-test | 31 | 49.10 | 12.43 | 2.27 | 3.18 | 2.23 | 5 |
| Total Enrollment | | | | | | | |
| Pre-test | 66 | 40.64 | 13.58 | 1.68 | | | |
| Post-test | 66 | 48.44 | 12.96 | 1.61 | 2.33 | 3.35 | 1 |

N = Number of students involved
M = Mean
SD = Standard deviation
σM = Standard deviation of the mean
σDiff = Standard error of the difference
t = t-ratio
% = Level of significance

## Attitude findings

In order to expose the attitudes of the students in connection with this course, an attitude inventory scale was administered to 81 of the 84

students enrolled. This was done at the end of the course at each of the four high schools involved.

The test which was used was developed by Curtis R. Finch of the Department of Vocational Education of Pennsylvania State University. The inventory scale was written as part of a Vocational-Industrial Education Research Report on the development of an instrument to measure student attitude toward individualized shop and laboratory instruction (13). A copy of the attitude inventory scale can be found in the appendix of this paper.

The results obtained from this scale are in charted form on the following ten pages in Table 2.

This table illustrates that, generally speaking, the attitudes of the students are favorable for the mobile unit program. For example, the majority of the group pointed out that they would like more instruction presented in this manner as shown in Question No. 1 of Table 2. They also felt that this instructional method seemed to be at least as valuable as regular classroom teaching (refer to Question No. 19 of Table 2). Question No. 39 of Table 2 illustrates further that the instruction which they received was well accepted. The higher percentages, both as individual schools and as a total group, demonstrate attitudes which are on the positive side.

Table 2. Attitude of students toward electronics instructor and mobile electronics classroom

SD = Strongly Disagree
D = Disagree
N = Neutral
A = Agree
SA = Strongly Agree
NA = Not Answered

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 1. | I would like more instruction presented in this way. | | | | | | | |
| | Milford High School | | | | 43 | 57 | | 100 |
| | Beaver High School | | | 8 | 42 | 50 | | 100 |
| | Millard High School | 3 | 10 | 13 | 23 | 51 | | 100 |
| | Delta High School | | | 16 | 28 | 56 | | 100 |
| | Total Average | 1 | 4 | 12 | 30 | 53 | | 100 |
| 2. | I learned more because equipment was available for me to use. | | | | | | | |
| | Milford High School | | | | 14 | 86 | | 100 |
| | Beaver High School | | 17 | 8 | 58 | 17 | | 100 |
| | Millard High School | 3 | | 3 | 43 | 51 | | 100 |
| | Delta High School | | | 6 | 47 | 47 | | 100 |
| | Total Average | 1 | 2 | 5 | 44 | 48 | | 100 |
| 3. | This instruction was very boring. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 50 | 42 | 8 | | | | 100 |
| | Millard High School | 40 | 37 | 10 | 10 | 3 | | 100 |
| | Delta High School | 60 | 31 | 6 | 3 | | | 100 |
| | Total Average | 51 | 36 | 7 | 5 | 1 | | 100 |
| 4. | The material presented was of much value to me. | | | | | | | |
| | Milford High School | | | 29 | 14 | 57 | | 100 |
| | Beaver High School | | | 8 | 50 | 42 | | 100 |
| | Millard High School | 3 | 13 | 13 | 41 | 30 | | 100 |
| | Delta High School | | | 6 | 41 | 50 | 3 | 100 |
| | Total Average | 1 | 5 | 11 | 40 | 42 | 1 | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 5. | The instruction was too specific. | | | | | | | |
| | Milford High School | 42 | 29 | 29 | | | | 100 |
| | Beaver High School | 8 | 92 | | | | | 100 |
| | Millard High School | 13 | 53 | 27 | 7 | | | 100 |
| | Delta High School | 25 | 50 | 19 | 3 | 3 | | 100 |
| | Total Average | 20 | 55 | 20 | 4 | 1 | | 100 |
| 6. | I was glad just to get through the material. | | | | | | | |
| | Milford High School | 58 | 14 | 14 | 14 | | | 100 |
| | Beaver High School | 50 | 33 | 17 | | | | 100 |
| | Millard High School | 27 | 43 | 23 | 7 | | | 100 |
| | Delta High School | 28 | 44 | 19 | 3 | 6 | | 100 |
| | Total Average | 33 | 40 | 20 | 5 | 2 | | 100 |
| 7. | The material presented will help me to solve problems. | | | | | | | |
| | Milford High School | | | 29 | 29 | 42 | | 100 |
| | Beaver High School | 8 | 8 | 8 | 43 | 33 | | 100 |
| | Millard High School | 3 | 3 | 23 | 51 | 20 | | 100 |
| | Delta High School | | 3 | 13 | 50 | 34 | | 100 |
| | Total Average | 2 | 4 | 17 | 47 | 30 | | 100 |
| 8. | While taking this instruction I almost felt as if someone was talking with me. | | | | | | | |
| | Milford High School | 14 | | | 43 | 43 | | 100 |
| | Beaver High School | | | 42 | 50 | 8 | | 100 |
| | Millard High School | 10 | 7 | 20 | 56 | 7 | | 100 |
| | Delta High School | | | 31 | 53 | 13 | 3 | 100 |
| | Total Average | 5 | 2 | 26 | 54 | 12 | 1 | 100 |
| 9. | I can apply very little of the material which I learned to a practical situation. | | | | | | | |
| | Milford High School | 58 | 14 | 14 | | 14 | | 100 |
| | Beaver High School | 25 | 58 | 17 | | | | 100 |
| | Millard High School | 27 | 50 | 13 | 10 | | | 100 |
| | Delta High School | 34 | 47 | 19 | | | | 100 |
| | Total Average | 32 | 47 | 16 | 4 | 1 | | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 10. | The material made me feel at ease. | | | | | | | |
| | Milford High School | | 14 | 14 | 58 | | 14 | 100 |
| | Beaver High School | | 25 | 25 | 50 | | | 100 |
| | Millard High School | 20 | 27 | 23 | 23 | 7 | | 100 |
| | Delta High School | | 6 | 13 | 59 | 19 | 3 | 100 |
| | Total Average | 7 | 17 | 19 | 45 | 10 | 2 | 100 |
| 11. | In view of the time allowed for learning, I felt that too much material was presented. | | | | | | | |
| | Milford High School | 43 | 43 | | 14 | | | 100 |
| | Beaver High School | 8 | 50 | 17 | 17 | 8 | | 100 |
| | Millard High School | 17 | 32 | 7 | 27 | 17 | | 100 |
| | Delta High School | 22 | 50 | 16 | 9 | 3 | | 100 |
| | Total Average | 20 | 43 | 11 | 17 | 9 | | 100 |
| 12. | I could pass an examination over the material which was presented. | | | | | | | |
| | Milford High School | | | | 57 | 43 | | 100 |
| | Beaver High School | | 8 | 42 | 42 | 8 | | 100 |
| | Millard High School | 10 | 13 | 37 | 23 | 17 | | 100 |
| | Delta High School | 6 | | 28 | 57 | 9 | | 100 |
| | Total Average | 6 | 6 | 31 | 42 | 15 | | 100 |
| 13. | I was more involved with using equipment than with understanding the material. | | | | | | | |
| | Milford High School | 43 | 57 | | | | | 100 |
| | Beaver High School | | 84 | 8 | 8 | | | 100 |
| | Millard High School | 10 | 57 | 13 | 7 | 13 | | 100 |
| | Delta High School | 16 | 41 | 19 | 18 | 6 | | 100 |
| | Total Average | 14 | 54 | 14 | 11 | 7 | | 100 |
| 14. | I became easily discouraged with this type of instruction. | | | | | | | |
| | Milford High School | 29 | 71 | | | | | 100 |
| | Beaver High School | 25 | 67 | 8 | | | | 100 |
| | Millard High School | 17 | 47 | 23 | 10 | 3 | | 100 |
| | Delta High School | 31 | 48 | 9 | 6 | 3 | 3 | 100 |
| | Total Average | 25 | 52 | 14 | 6 | 2 | 1 | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 15. | I enjoy this type of instruction because I get to use my hands. | | | | | | | |
| | Milford High School | | 14 | 14 | 43 | 29 | | 100 |
| | Beaver High School | | | 42 | 43 | 17 | | 100 |
| | Millard High School | 7 | 10 | 30 | 40 | 13 | | 100 |
| | Delta High School | 3 | | 9 | 54 | 31 | 3 | 100 |
| | Total Average | 4 | 5 | 22 | 46 | 22 | 1 | 100 |
| 16. | I was not sure how much I learned while taking this instruction. | | | | | | | |
| | Milford High School | 29 | 42 | | 29 | | | 100 |
| | Beaver High School | | 42 | 33 | 25 | | | 100 |
| | Millard High School | 10 | 27 | 23 | 37 | 3 | | 100 |
| | Delta High School | 9 | 38 | 31 | 19 | 3 | | 100 |
| | Total Average | 10 | 35 | 26 | 27 | 2 | | 100 |
| 17. | There are too many distractions with this method of instruction. | | | | | | | |
| | Milford High School | 43 | 57 | | | | | 100 |
| | Beaver High School | 25 | 50 | 8 | 17 | | | 100 |
| | Millard High School | 20 | 43 | 30 | 7 | | | 100 |
| | Delta High School | 28 | 63 | 6 | | 3 | | 100 |
| | Total Average | 26 | 53 | 15 | 5 | 1 | | 100 |
| 18. | The material which I learned will help me when I take more instruction in this area. | | | | | | | |
| | Milford High School | | | | 29 | 71 | | 100 |
| | Beaver High School | | | | 58 | 42 | | 100 |
| | Millard High School | 3 | | 20 | 44 | 33 | | 100 |
| | Delta High School | | | 9 | 47 | 44 | | 100 |
| | Total Average | 1 | | 11 | 46 | 42 | | 100 |
| 19. | This instructional method did not seem to be any more valuable than regular classroom instruction. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 17 | 66 | 17 | | | | 100 |
| | Millard High School | 41 | 30 | 13 | 13 | 3 | | 100 |
| | Delta High School | 31 | 57 | 6 | 3 | 3 | | 100 |
| | Total Average | 35 | 47 | 10 | 6 | 2 | | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 20. | I felt that I wanted to do my best while taking this instruction. | | | | | | | |
| | Milford High School | 14 | | 14 | 29 | 43 | | 100 |
| | Beaver High School | | | 8 | 75 | 17 | | 100 |
| | Millard High School | | 10 | 13 | 41 | 33 | 3 | 100 |
| | Delta High School | | | 9 | 57 | 34 | | 100 |
| | Total Average | 1 | 4 | 11 | 51 | 32 | 1 | 100 |
| 21. | This method of instruction makes learning too mechanical. | | | | | | | |
| | Milford High School | 29 | 57 | | | 14 | | 100 |
| | Beaver High School | 8 | 67 | 25 | | | | 100 |
| | Millard High School | 17 | 46 | 30 | 7 | | | 100 |
| | Delta High School | 34 | 50 | 13 | 3 | | | 100 |
| | Total Average | 23 | 53 | 19 | 4 | 1 | | 100 |
| 22. | The instruction has increased my ability to think. | | | | | | | |
| | Milford High School | | 14 | 14 | 29 | 43 | | 100 |
| | Beaver High School | | 8 | 8 | 51 | 33 | | 100 |
| | Millard High School | 3 | 13 | 17 | 57 | 10 | | 100 |
| | Delta High School | | 3 | 19 | 59 | 16 | 3 | 100 |
| | Total Average | 1 | 9 | 16 | 54 | 19 | 1 | 100 |
| 23. | I had difficulty reading the written material that was used. | | | | | | | |
| | Milford High School | 43 | 57 | | | | | 100 |
| | Beaver High School | 25 | 50 | 17 | 8 | | | 100 |
| | Millard High School | 20 | 53 | 7 | 17 | 3 | | 100 |
| | Delta High School | 25 | 44 | 25 | | 3 | 3 | 100 |
| | Total Average | 25 | 50 | 15 | 7 | 2 | 1 | 100 |
| 24. | I felt frustrated by the instructional situation. | | | | | | | |
| | Milford High School | 43 | 43 | | 14 | | | 100 |
| | Beaver High School | 25 | 50 | 17 | 8 | | | 100 |
| | Millard High School | 17 | 43 | 27 | 13 | | | 100 |
| | Delta High School | 28 | 47 | 19 | 6 | | | 100 |
| | Total Average | 25 | 45 | 20 | 10 | | | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 25. | This is a poor way for me to learn skills. | | | | | | | |
| | Milford High School | 71 | 29 | | | | | 100 |
| | Beaver High School | 33 | 67 | | | | | 100 |
| | Millard High School | 33 | 44 | 13 | 7 | 3 | | 100 |
| | Delta High School | 41 | 56 | | 3 | | | 100 |
| | Total Average | 40 | 50 | 5 | 4 | 1 | | 100 |
| 26. | This method of instruction does not seem to be any better than other methods of instruction. | | | | | | | |
| | Milford High School | 29 | 57 | 14 | | | | 100 |
| | Beaver High School | | 75 | 17 | 8 | | | 100 |
| | Millard High School | 30 | 37 | 23 | 10 | | | 100 |
| | Delta High School | 31 | 44 | 25 | | | | 100 |
| | Total Average | 26 | 47 | 22 | 5 | | | 100 |
| 27. | I am interested in trying to find out more about the subject matter. | | | | | | | |
| | Milford High School | | 14 | | 29 | 57 | | 100 |
| | Beaver High School | | | 17 | 58 | 25 | | 100 |
| | Millard High School | 7 | 13 | 27 | 23 | 30 | | 100 |
| | Delta High School | | 3 | 28 | 44 | 25 | | 100 |
| | Total Average | 2 | 7 | 23 | 38 | 30 | | 100 |
| 28. | It was hard for me to follow the order of this instruction. | | | | | | | |
| | Milford High School | 29 | 71 | | | | | 100 |
| | Beaver High School | 8 | 76 | 8 | 8 | | | 100 |
| | Millard High School | 13 | 37 | 23 | 20 | 7 | | 100 |
| | Delta High School | 22 | 50 | 16 | 9 | 3 | | 100 |
| | Total Average | 17 | 51 | 16 | 12 | 4 | | 100 |
| 29. | While taking this instruction I felt isolated and alone. | | | | | | | |
| | Milford High School | 71 | 29 | | | | | 100 |
| | Beaver High School | 25 | 50 | 17 | | 8 | | 100 |
| | Millard High School | 30 | 50 | 10 | 10 | | | 100 |
| | Delta High School | 41 | 50 | 3 | 3 | 3 | | 100 |
| | Total Average | 37 | 49 | 7 | 5 | 2 | | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 30. | I felt uncertain as to my performance in the instruction. | | | | | | | |
| | Milford High School | 29 | 28 | 14 | 29 | | | 100 |
| | Beaver High School | 8 | 26 | 33 | 33 | | | 100 |
| | Millard High School | 10 | 37 | 30 | 23 | | | 100 |
| | Delta High School | 13 | 37 | 19 | 25 | | 6 | 100 |
| | Total Average | 12 | 35 | 25 | 26 | | 2 | 100 |
| 31. | There was enough time to learn the material that was presented. | | | | | | | |
| | Milford High School | 29 | 28 | | 29 | 14 | | 100 |
| | Beaver High School | 25 | 34 | 33 | 8 | | | 100 |
| | Millard High School | 30 | 40 | 10 | 13 | 7 | | 100 |
| | Delta High School | 6 | 25 | 28 | 32 | 3 | 6 | 100 |
| | Total Average | 20 | 32 | 20 | 21 | 5 | 2 | 100 |
| 32. | I don't like this instruction any better than other kinds I have had. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 33 | 42 | 25 | | | | 100 |
| | Millard High School | 33 | 33 | 20 | 7 | 7 | | 100 |
| | Delta High School | 28 | 53 | 13 | | | 6 | 100 |
| | Total Average | 33 | 45 | 16 | 2 | 2 | 2 | 100 |
| 33. | The material presented was difficult to understand. | | | | | | | |
| | Milford High School | 29 | 43 | 14 | 14 | | | 100 |
| | Beaver High School | 17 | 50 | 8 | 25 | | | 100 |
| | Millard High School | 10 | 23 | 40 | 17 | 10 | | 100 |
| | Delta High School | 16 | 25 | 31 | 22 | | 6 | 100 |
| | Total Average | 15 | 30 | 29 | 20 | 4 | 2 | 100 |
| 34. | This was a very good way to learn the material. | | | | | | | |
| | Milford High School | | | | 29 | 71 | | 100 |
| | Beaver High School | | | 17 | 58 | 25 | | 100 |
| | Millard High School | 3 | 13 | 10 | 44 | 30 | | 100 |
| | Delta High School | | | 13 | 53 | 25 | | 100 |
| | Total Average | 1 | 4 | 11 | 49 | 31 | 4 | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 35. | I felt very uneasy while taking this instruction. | | | | | | | |
| | Milford High School | 43 | 57 | | | | | 100 |
| | Beaver High School | 33 | 51 | 8 | 8 | | | 100 |
| | Millard High School | 13 | 44 | 23 | 10 | 7 | 3 | 100 |
| | Delta High School | 28 | 48 | 9 | 9 | | 6 | 100 |
| | Total Average | 25 | 46 | 14 | 9 | 2 | 4 | 100 |
| 36. | The material presented seemed to fit in well with my previous knowledge of the subject. | | | | | | | |
| | Milford High School | 14 | | 14 | 29 | 43 | | 100 |
| | Beaver High School | | 8 | 25 | 50 | 17 | | 100 |
| | Millard High School | 7 | 20 | 27 | 36 | 10 | | 100 |
| | Delta High School | | 6 | 41 | 34 | 13 | 6 | 100 |
| | Total Average | 4 | 11 | 31 | 37 | 15 | 2 | 100 |
| 37. | This method of instruction was a poor use of my time. | | | | | | | |
| | Milford High School | 57 | 29 | | | 14 | | 100 |
| | Beaver High School | 59 | 33 | 8 | | | | 100 |
| | Millard High School | 50 | 17 | 13 | 10 | 10 | | 100 |
| | Delta High School | 37 | 51 | 6 | | | 6 | 100 |
| | Total Average | 47 | 33 | 9 | 4 | 5 | 2 | 100 |
| 38. | While taking this instruction I felt challenged to do my best work. | | | | | | | |
| | Milford High School | | | | 43 | 57 | | 100 |
| | Beaver High School | | | 17 | 58 | 25 | | 100 |
| | Millard High School | 3 | 10 | 17 | 40 | 27 | 3 | 100 |
| | Delta High School | | | 9 | 54 | 31 | 6 | 100 |
| | Total Average | 1 | 4 | 12 | 48 | 31 | 4 | 100 |
| 39. | I dislike the way that I was instructed. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 42 | 50 | 8 | | | | 100 |
| | Millard High School | 30 | 37 | 23 | 7 | 3 | | 100 |
| | Delta High School | 41 | 47 | 6 | | | 6 | 100 |
| | Total Average | 38 | 45 | 12 | 2 | 1 | 2 | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 40. | The instruction gave me facts not just talk. | | | | | | | |
| | Milford High School | | | | 71 | 29 | | 100 |
| | Beaver High School | | | 8 | 75 | 17 | | 100 |
| | Millard High School | | 7 | 13 | 50 | 27 | 3 | 100 |
| | Delta High School | | | 3 | 66 | 25 | 6 | 100 |
| | Total AVerage | | 2 | 7 | 62 | 25 | 4 | 100 |
| 41. | I guessed at most of the answers to problems. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 25 | 58 | 17 | | | | 100 |
| | Millard High School | 41 | 33 | 20 | 3 | 3 | | 100 |
| | Delta High School | 44 | 37 | 13 | | | 6 | 100 |
| | Total Average | 41 | 40 | 15 | 1 | 1 | 2 | 100 |
| 42. | Answers were given to the questions that I had about the material. | | | | | | | |
| | Milford High School | | | | 43 | 57 | | 100 |
| | Beaver High School | | 17 | 8 | 67 | 8 | | 100 |
| | Millard High School | 7 | | 17 | 52 | 17 | 7 | 100 |
| | Delta High School | | 3 | 6 | 54 | 31 | 6 | 100 |
| | Total Average | 2 | 4 | 10 | 54 | 25 | 5 | 100 |
| 43. | I seemed to learn very slowly with this type of instruction. | | | | | | | |
| | Milford High School | 43 | 43 | 14 | | | | 100 |
| | Beaver High School | 8 | 68 | 8 | 8 | 8 | | 100 |
| | Millard High School | 30 | 34 | 30 | 3 | 3 | | 100 |
| | Delta High School | 34 | 38 | 16 | 6 | | 6 | 100 |
| | Total Average | 30 | 41 | 20 | 5 | 2 | 2 | 100 |
| 44. | This type of instruction makes me want to work harder. | | | | | | | |
| | Milford High School | | | 14 | 57 | 29 | | 100 |
| | Beaver High School | | | 17 | 66 | 17 | | 100 |
| | Millard High School | 7 | 10 | 20 | 53 | 10 | | 100 |
| | Delta High School | | 3 | 28 | 41 | 22 | 6 | 100 |
| | Total Average | 2 | 5 | 22 | 52 | 17 | 2 | 100 |

Table 2. Continued

All figures are given in percentages

| No. | Question | SD | D | N | A | SA | NA | Total |
|---|---|---|---|---|---|---|---|---|
| 45. | I did not understand the material that was presented. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 25 | 51 | 8 | 8 | 8 | | 100 |
| | Millard High School | 13 | 50 | 20 | 10 | 7 | | 100 |
| | Delta High School | 28 | 40 | 13 | 13 | | 6 | 100 |
| | Total Average | 25 | 45 | 14 | 10 | 4 | 2 | 100 |
| 46. | I felt as if I had my own teacher while taking this instruction. | | | | | | | |
| | Milford High School | | | 29 | 29 | 42 | | 100 |
| | Beaver High School | 8 | 8 | 25 | 51 | 8 | | 100 |
| | Millard High School | 13 | 13 | 17 | 47 | 10 | | 100 |
| | Delta High School | | 3 | 19 | 44 | 28 | 6 | 100 |
| | Total Average | 6 | 7 | 20 | 45 | 20 | 2 | 100 |
| 47. | I felt that no one really cared whether I worked or not. | | | | | | | |
| | Milford High School | 57 | 43 | | | | | 100 |
| | Beaver High School | 33 | 51 | 8 | 8 | | | 100 |
| | Millard High School | 47 | 33 | 13 | 7 | | | 100 |
| | Delta High School | 48 | 31 | 9 | 3 | 3 | 6 | 100 |
| | Total Average | 46 | 36 | 10 | 5 | 1 | 2 | 100 |

Student questionnaire results

A questionnaire was prepared for the purpose of determining student opinions and evaluations which were not brought forth in the attitude inventory scale or the pre-test and post-test. At Delta High School these questionnaires were handed to the students to be filled out after they had completed the attitude sheet. Questionnaires were mailed to the other three schools to be filled out and returned to the author. All questionnaires were filled out anonymously.

Of the 84 questionnaires given out, 78 were filled out and returned. Therefore, all percentages are figured on the basis of 78 questionnaires. A copy of the questionnaire which was used is located in Appendix B of this report.

The following table shows the results of Question No. 1.

Table 3. Students' occupational plans

| Occupational area | Percentage |
|---|---|
| Electronics technology | 11.5 |
| Mechanic | 10.3 |
| Engineering | 7.7 |
| Electronics engineer | 6.4 |
| Computer programming | 5.1 |
| Agriculture | 3.8 |
| Veterinarian | 3.8 |
| Contracting | 1.3 |
| Drafting | 1.3 |
| Forestry | 1.3 |
| Housewife | 1.3 |
| Heavy equipment operator | 1.3 |
| Industrial arts | 1.3 |
| Lawyer | 1.3 |
| Medicine | 1.3 |
| Police officer | 1.3 |
| Psychology | 1.3 |
| Refrigeration | 1.3 |
| Welding | 1.3 |
| X-ray technician | 1.3 |
| Not electronics | 3.8 |
| Undecided | 23.0 |
| Omitted | 7.7 |

Twenty occupations were listed. The number shows what percentage of the 78 students listed that occupation. At the end of the table it is shown that 3.8 percent of the students simply wrote that they discovered they were not interested in electronics.

The chart also shows that 23 percent of the students were undecided in their future occupational choices and 7.7 percent did not respond to this particular question.

Table 4, the second question of the questionnaire, lists three answers which were given.

Table 4. How students were selected for the program

| Response | Percentage |
|---|---|
| It was my own choice | 51.0 |
| The class I was attending went to the mobile unit | 34.6 |
| I was forced into it | 3.9 |
| No response | 10.3 |

The students were asked the question if the program stimulated their interest in the field of electronics. Eighty-seven percent answered yes and 13 percent answered no to the question.

The response shows that the vast majority had their interest aroused in the electronics area.

The students were asked the question whether a longer stay with the unit at their school would be advantageous over the period which they had. Ninety-two percent answered yes and 8 percent answered no to the question. The students who answered yes were then asked how long they would recommend staying at the unit, as shown in Table 5. The highest percentage felt that 12 weeks would be a sufficient period of time in which to cover the subject.

Table 5. Students' recommendations as to the length of time the unit should stay at each school

| Recommendation | Percentage |
|---|---|
| 12 weeks | 30.5 |
| All year | 25.0 |
| 1 semester (16 weeks) | 19.5 |
| 6 months | 4.2 |
| 10 weeks | 4.2 |
| 8 weeks | 4.2 |
| Until more learning takes place | 2.8 |
| 6 weeks | 2.8 |
| 9 weeks | 1.4 |
| 5 weeks | 1.4 |
| As long as possible | 1.4 |
| Long enough to make it possible to get one-half credit for the course | 1.4 |
| No response | 1.4 |

The fifth question was a "yes" or "no" question which asked the students if they thought the mobile electronics program coming into their school once a year for a short period would give them the opportunities they want in electronics. Sixty percent of the students answered yes, 37 percent answered no and 3 percent did not respond to the question.

In the sixth question, which asked the students if they missed another class in order to participate in the electronics program, 66, or 85 percent answered yes and 15 percent answered no. Those students who did miss another class in order to participate in the electronics program answered the second question which asked if they had any difficulty in making up the work which they missed. Eighty three percent of these 66 stated that they did not have any trouble making up the work which they missed.

Number seven of the questionnaire was not specifically a question.

It was included for the purpose of giving the students a last opportunity to express their feelings about the program.

Table 6 is not figured on a percentage basis. It simply contains information relating to the frequency of certain ideas. Each time an opinion was expressed, it was tallied on the table, so that the table illustrates how many times particular ideas were revealed.

The table also shows that 30 of the 78 students made no comment on this last section of the questionnaire.

Table 6. Students' comments and opinions about electronics program

| Comment or opinion | Number |
|---|---|
| 1. It is a very good program. | 31 |
| 2. The unit needs to stay longer. | 19 |
| 3. This program motivated my interest in electronics or else made me realize that I am not interested in electronics. | 12 |
| 4. Keep the program going. | 9 |
| 5. The amount and quality of equipment helped. | 6 |
| 6. The instructor was very good. | 6 |
| 7. This class was challenging to me. | 3 |
| 8. I would like to have had the opportunity of taking this class before my senior year. | 2 |
| 9. The lab needs more room for working. | 1 |
| 10. The labs were good. | 1 |
| 11. The material was covered too fast. | 1 |
| 12. I hope the lab doesn't come back. | 1 |
| 13. I would like to work more with the amateur radio. | 1 |
| 14. It would be helpful to have a book and notebook on electronics to have with the course. | 1 |
| 15. It would be helpful to screen the applicants prior to the course and assign class levels. | 1 |
| 16. This is a novel idea. | 1 |
| 17. The mobile lab would make a good accompaniment to a regular, full year course. | 1 |
| 18. I would like to have the lab come as a special summer school course. | 1 |
| No comment. | 30 |

Relationships between personal student records and success in this class

In order to determine if a correlation occurs between a student's success in an electronics class and his previous math experience and math abilities, the cumulative records of the participating students were studied. Information was recorded on 57 junior and senior students. The following table displays this material.

The first list of numbers represents the electronics class grade point on the following basis: 4 = A, 3 = B, 2 = C, and 1 = D. If a zero is recorded, the student failed in electronics. The second column of numbers gives an average grade point of all math classes which were taken previous to the electronics class. The numbers in the final column were taken from numerical aptitude section of the GATB test. This percentile should represent the student's ability to perform arithmetic operations quickly and accurately.

Table 7. Correlation between students' success in an electronics class and their previous math experience

| Electronics Grade | Math Experience | Numerical Aptitude (GATB) |
|---|---|---|
| 4 | 4.0 | 64 |
| 4 | 2.5 | 27 |
| 4 | 3.8 | 60 |
| 4 | 2.3 | 40 |
| 4 | 3.5 | 69 |
| 4 | 2.9 | 60 |
| 4 | 3.8 | 64 |
| 4 | 3.5 | 40 |
| 4 | 3.5 | 77 |
| 4 | 1.8 | 48 |
| 4 | 2.2 | 86 |
| 4 | 1.2 | 27 |
| 4 | 1.5 | 31 |
| 4 | 2.4 | 34 |
| 4 | 3.0 | 67 |
| 4 | 3.3 | 64 |
| 4 | 1.8 | 67 |
| 4 | 2.8 | 64 |
| 4 | 2.4 | 74 |
| 4 | 3.6 | 60 |
| 4 | 2.8 | 52 |
| 4 | 4.0 | 87 |
| 4 | 4.0 | 71 |
| 4 | 1.8 | 33 |
| 4 | 4.0 | 79 |
| 4 | 4.0 | 95 |
| 4 | 2.8 | 18 |
| 3 | 2.4 | 21 |
| 3 | 3.0 | 52 |
| 3 | 2.5 | 38 |
| 3 | 1.3 | 52 |
| 3 | 2.0 | 27 |
| 3 | 2.3 | 24 |
| 3 | 1.0 | 13 |
| 3 | 3.0 | 71 |
| 3 | 2.6 | 62 |
| 3 | 2.7 | 52 |
| 3 | 2.0 | 60 |
| 2 | 1.8 | 34 |
| 2 | 2.3 | 76 |
| 2 | 2.0 | 29 |
| 2 | 2.3 | 42 |
| 2 | 1.3 | 12 |
| 2 | 1.0 | 12 |
| 2 | 1.8 | 31 |
| 2 | 1.8 | 41 |

Table 7. Continued

| Electronics Grade | Math Experience | Numerical Aptitude (GATB) |
|---|---|---|
| 2 | 3.0 | 56 |
| 2 | 2.7 | 13 |
| 2 | 2.0 | 26 |
| 2 | 2.8 | 52 |
| 2 | 2.7 | 21 |
| 1 | 1.8 | 21 |
| 1 | 1.0 | 26 |
| 1 | 1.1 | 31 |
| 1 | 1.6 | 38 |
| 0 | 2.5 | 60 |
| 0 | 1.5 | 71 |

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# APPENDIX A

## Correspondence

### PERSONAL INTERVIEW OF THE COURSE INSTRUCTOR, MR. KEN MUMFORD

Grant: Well, Ken, what do you think of this electronics unit?

Mr. Mumford: After having worked with it and its development for about a year or so, and also having taught it for about half a year, I have come to the conclusion that it is a very valuable piece of equipment, which, if used efficiently, could open a whole new gateway to the educational system as we know it now.

Grant: What are some of the advantages of this over a regular class?

Mr. Mumford: One advantage that has been pointed out to me both by teachers and by many students in discussion is that they like the atmosphere of getting out of a classroom and into a situation like we have here in the van. It's a learning atmosphere; it's an electronics atmosphere. The students get out here, and they feel like they're part of the program. They are working with it. We have a lot of good equipment, and that has been one real strong point.

Grant: Is this because schools often can't afford good equipment?

Mr. Mumford: Many of the schools can't afford to have this equipment. Through my experience at the College of Southern Utah and talking to teachers at other technical schools, I've noticed that students who come into the vocational and technical program come from some of the larger schools up north and have a background in electronics. Because of their high school experience, they have a definite advantage. The students from the smaller schools don't have this type of program and have really been handicapped. Just from the experience that I have had so far, I feel that these students that go on to a technical school or college in any vocational program will have a real jump on other students, or actually have an advantage.

Grant: Do you feel that the six weeks is long enough for a depth in electronics?

Mr. Mumford: No definitely not. Six weeks is not long enough. Next year we will be offering this program on a nine week basis, and we hope it extends out to a twelve week basis. We just get the students so they start to feel like they are really accomplishing something, and we have to pull the plug out and go on to some other place.

Grant: Then you could have an advanced course next year?

Mr. Mumford: Yes, definitely. The students that have had the first year program this year will start learning about vacuum tubes and semi-conductors and oscillator circuits, amplifier circuits, power supplies, and circuitry when we come back next year. In this way they will become familiar with the basic electronic devices.

Grant: Was each school primarily basic or was one school advanced?

Mr. Mumford: At Milford High School in part of their program down there, their physics teacher and chemistry teacher had some background in the service in electronics, and they had been presenting a program up through basic vacuum tube circuits. This was the first school we had gone to, and prior to going there, the teacher had asked us if we could just start right off in solid state circuitry. Therefore, the entire six week period was spent in solid state circuitry and different types of solid state devices. We didn't get into antennas and things like this, but it was spent in solid state. At the other schools, we started off with basic DC and worked up through series circuits, parallel circuits, series circuit parallel combinations, and the Kirchoff's Law and then started into alternating current. Here at this last school, we haven't really had time to get into alternating current, but the other schools were able to talk about resonance and reactances. One advantage to this which we found that might interest you is that we have been able to correlate this program with other programs that are already existing in the school. For example, at Fillmore High School we had a trigonometry teacher that came right into the class with the students. In fact, he was in there almost every day. He came during his free period. We were able to correlate what the students were learning in trig with phase relationships and impedances and all these things that we talk about in alternating current. Also at Fillmore, some of the teachers in English had students that had transferred from English to the electronics program. They were able to work out the requirements for the English classes by writing informative papers and giving interesting demonstrations to the rest of the English classes. This proved to be quite beneficial to them, because it was in an area that was very interesting to them.

Grant: Okay. Did you recognize any disadvantages?

Mr. Mumford: No, we haven't found any major disadvantages at all. This has been mainly because the administrators, principals, superintendants, and other teachers that we have worked with have been very cooperative. We really have not had any problems at all. The students have been willing to get in and work with us. It is difficult for some teachers to have a student leave their class for nine weeks and then come back and try to join the rest of the class. This creates a problem. Therefore, we have to figure out a way to correlate things, but as I said, the administrators and other teachers have just been fantastic about this. We really have not had any problems because they have wanted to see this thing go.

Grant: Do you have any problems linked with not having a restroom?

Mr. Mumford: No. We give them a five to ten minute break between classes. This is when they would be regularly shifting between classes anyway. Having them for two hours straight is also quite an advantage. When they have just one hour labs, they just have time to get things set up, and it's time to take them down. This two hour block that the schools have been kind enough to give us has really worked out remarkably well.

Grant: That's a good point. In electronics you wouldn't have a chance to set up an experiment in the lab in a one hour span.

Mr. Mumford: Right. We have found out that one thing we definitely need to do is work out a program where we can get the students in more matched groups. We have had some extremely fast students and some extremely slow students. This has created some problems in keeping interest and providing motivation. At Fillmore we had one class first period in the morning where we had the top students in the whole high school. If at any time in the past a student had expressed a desire to do something in electronics, mathematics, engineering, or anything related, he was put into this class. This group was fantastic. You just couldn't give them information fast enough. However the other schools, and also the rest of the classes we had there at Fillmore, ran into the problem of having some slow students in with some fast students. We have found several students who are definitely planning to go into this area, and we have also found a lot that have been definitely converted to the fact that they don't want any more to do with electronics. As we tell them, "that's perfectly great!" That is what we are after. If they can decide that it is an area they would like to go into, then they have had a chance to look through it and examine it and find out they can work in the area. If they find out they do not want anything to do with it, that is great, too. We have accomplished a purpose.

Grant: To find out if they are interested then is quite beneficial. Is the six week period long enough for them to do this?

Mr. Mumford: That's right. You know we have here in the van a complete radio station, and we have the opportunity to let several students talk to far away countries or just get acquainted with amateur radio (refer to Figures 4 and 5). We have several students who are interested in getting licenses, so it all works well for them in picking up a hobby if they are interested in it. For the advanced class which we had at Milford, I tried to work out a system in which each Friday the students would have a day when they could build projects, trouble shoot radios or TVs, or work on anything they wanted to bring in (refer to Figure 6). In that situation where some students had some background they were able to do this. It worked out fine. We tried the same thing at Beaver High School, and we learned from it. We found out that the students have to have some background before they can handle this time efficiently.

Grant: In other words, at Beaver you had to do almost all of the repair?

Mr. Mumford: I did do almost all of the repair work, but at least they brought a lot of things in. They wanted to spend most of their time working with the short wave radio. This is fine if it is an experience which they gain something from. However, you have to be really careful. They try to lead you off if you don't watch it.

Grant: Now here at Delta you haven't had open class on Fridays?

Mr. Mumford: No, we haven't had open class on Fridays. We've tried to allow half the period as a make up time for those who had fallen behind

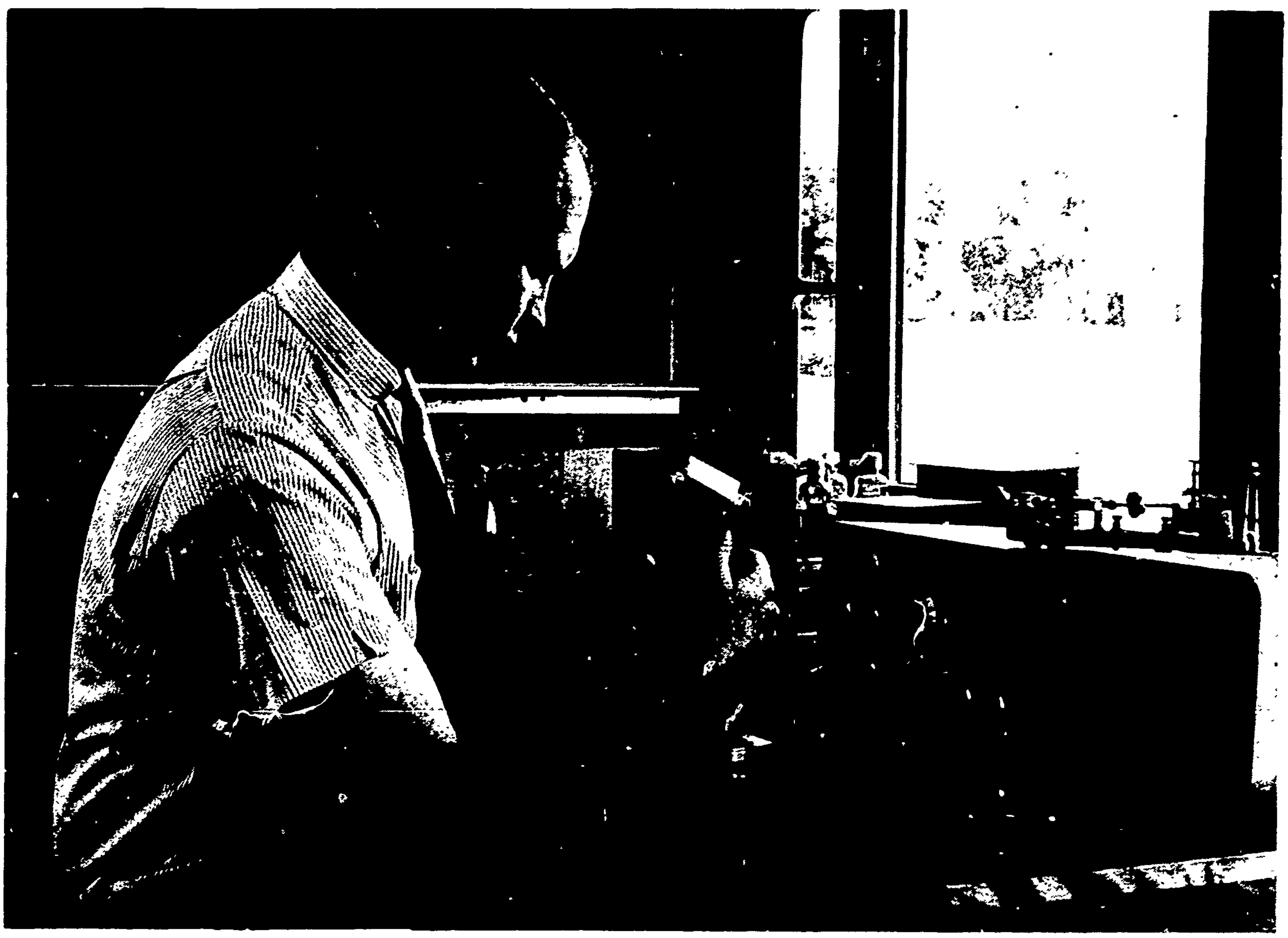


Figure 4. Mobile van equipped with complete radio station.

Figure 5. Mobile van equipped with complete radio stations.

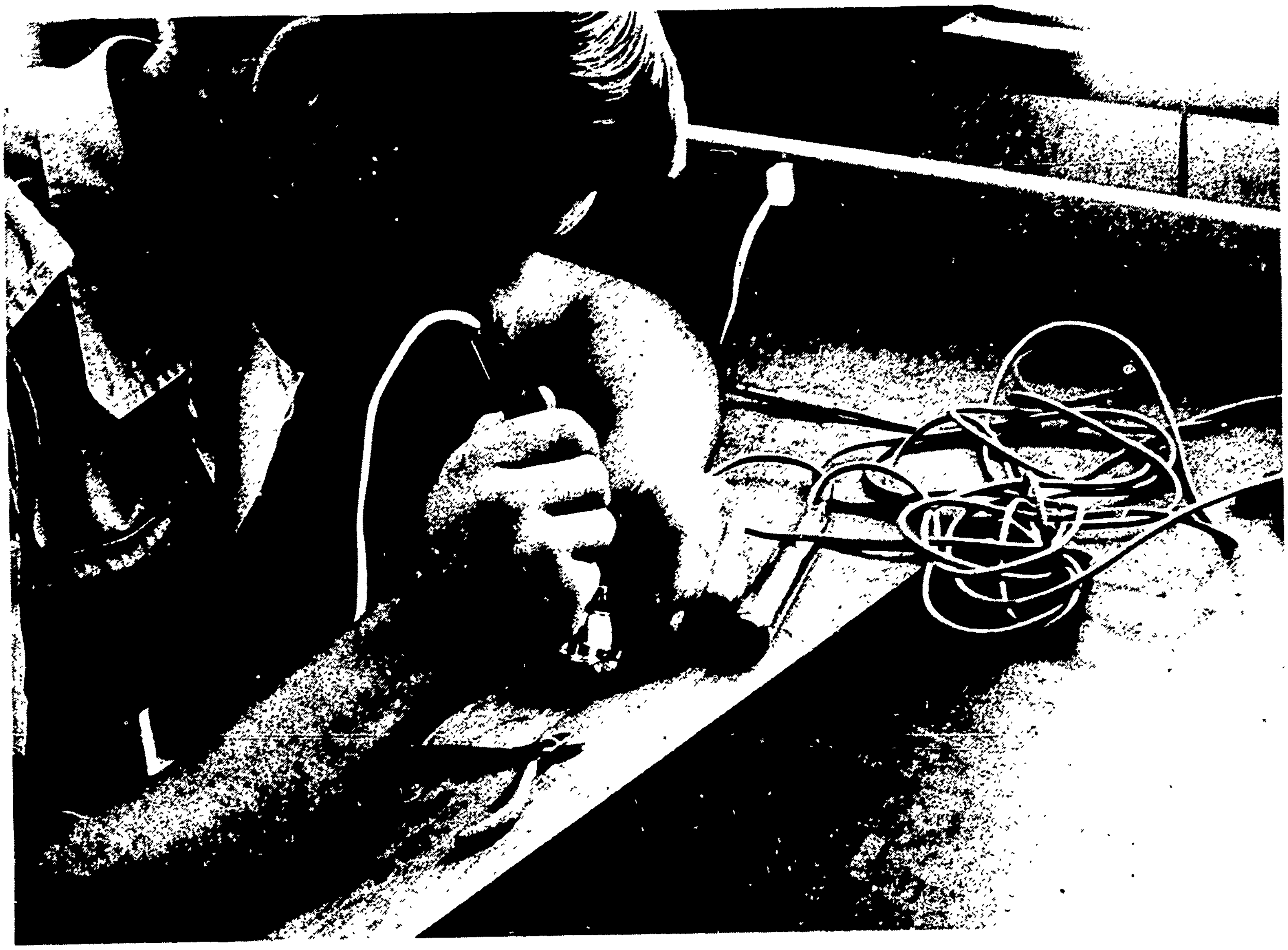


Figure 6. Student working on electronic equipment.

in a lab or something; or, if students had an interest in short wave and were caught up in their work, they could go up and work around the short wave. I would tune it up, put it on the air, and let them talk to people while I was right there to watch what was going on.

Grant: Didn't the faculty come out one day from Fillmore to visit?

Mr. Mumford: Oh, yes, I've had many faculty members come out, especially the science teachers. They like to come out and see what we are doing. Right here at Delta High School one thing we have done with the physics department is to let them use the equipment which we have when they are talking about different types of wave forms and frequency and this type of thing. We let them take generators and oscilloscopes. We just try to work with them as best we can so that all of us gain. As I said before, they have just been marvelously cooperative with us in every way. We haven't had any discipline problems either. Amazingly enough, we have had a few things that have really tickled us. We had some fellows down at Fillmore who had probably never passed a class in their entire high school existence. They came out with A's in this class, and they really earned them. They were right up there in the top. They just finally found something they could catch on to. I feel that if you can just do this for a few students, it makes the whole thing worthwhile because they finally found something they could succeed at.

Grant: Electronics can be hard and has the reputation of being difficult, don't you think?

Mr. Mumford: Yes, we try to go about it from a practical standpoint. All of the mathematics which they have learned we try to make meaningful. Every time they apply something they have learned, they can see why they are working a math problem or they can see why they should do it this way instead of another way. When you go about it in this way, it's really not that difficult for them. I haven't found very many students that couldn't at least gain something from it. However, the minute you start slapping big formulas on the board without going through and explaining every detail, the students start to get lost and confused.

Grant: Do you think that we could do more work with adults?

Mr. Mumford: I know that the adult class program will go over as well or better than the program at the high school. At both Milford and Beaver we conducted adult night classes. We had one night class where we worked with computors and multi-vibrator circuits and this type of advanced electronics. We had another class that started from scratch. These were both at Milford. At Beaver when we called a group together, they decided they wanted a house wiring class. So we have all the equipment here now for house wiring. We've been teaching house wiring and some things that that are really valuable to adults. Both at Fillmore and here at Delta we weren't able to get night classes going as we had hoped to do, but I am sure they will go this coming year because there has been a great deal of interest expressed in this. I know it will go like wild fire because in areas such as Beaver they have been having trouble getting night classes going, and we had no trouble whatsoever picking up all of the students we needed. Every time I would walk down the street someone would

say, "aren't you connected with that van? When are you going to start an adult night class?" It is an area that people are interested in.

Grant: Everyone can use some electronics.

Mr. Mumford: Yes, I really think it has some great possibilities. I can see in the future there will be a lot more of these units going around. Right now we have more demand than we have units to go around.

Grant: Didn't you have a few girls in your classes?

Mr. Mumford: Here at Delta is the first time we have had girls taking the class. As we told them when we started, there is a great demand for women in electronics. In fact they do a good part of the electrical wiring. (Refer to Figure 7.)

Grant: All the assembly work.

Mr. Mumford: Right, assembly work and much of the little soldering details that are done on integrated circuits and transistors and things like this. The women do a lot of these things, and we were tickled to get these gals in here. We have two girls that are kind of considered the "cards" of the school, and they both did really well. One girl had trouble with the slide rule at first, but before she finished, she just loved the slide rule and we couldn't keep her away from it. By the way, that is one thing we try to teach as we go through this, just to save us time if nothing else. The girls did very well. They scored right up in the top and some of them right in the middle, but they did try. We didn't have any problem. They all worked.

Grant: Do you think any housewives would be interested in the adult classes?

Mr. Mumford: I don't know. I don't see any reason why they shouldn't be, if their husbands aren't worried about them coming out with a little better background than they have. One other thing that was interesting to me was the variations in age level. We had ninth graders enrolled in our classes at both Beaver and Delta. These ninth graders have had special aptitude and interest in electronics, and every one of them has done an excellent job. Here at Delta we had one young fellow in the ninth grade who scored right up at the top with seniors in high school. Students like this who are interested and are on special science programs come in and just really eat it up.

Grant: Then if there were more vans and more opportunities, even junior high kids might be interested in the program?

Mr. Mumford: Oh, yes. Everyday at lunch time we have had junior high kids come streaming to the door wanting to know if they can come in and look around. They like to look at the oscilloscopes and short wave. After school and in the evenings kids come in and walk around, and these are prospective students for the coming years.

Grant: Okay. Thanks, Ken!

Mr. Mumford: Right!

Figure 7. There is a great demand for women in electronics.

2

Letters sent out in search of states which have had previous experience with mobile units.

| IN | RCU | YES | NO | NOTE COMMENTS | |
|---|---|---|---|---|---|
| X | Alabama | | X | | |
| | Arkansas | | | | |
| X | Arizona | X | | | |
| X | California | | X | X | |
| X | Colorado | | X | X | |
| | Connecticut | | | | |
| | Delaware | | | | |
| X | Florida | | X | | |
| | Georgia | | | | |
| X | Hawaii | | X | | |
| X | Idaho | | X | | |
| X | Illinois | | X | | |
| | Indiana | | | | |
| X | Iowa | | X | | |
| X | Kansas | | X | X | Will have one |
| X | Kentucky | | X | | |
| X | Louisiana | | X | | |
| | Massachusetts | | | | |
| X | Michigan | | X | | |
| X | Minnesota | | X | | |
| X | Mississippi | | X | | |
| X | Missouri | | X | | |
| X | Montana | | X | | |
| X | Nebraska | | X | | |
| X | Nevada | | X | | |
| X | New Hampshire | | X | | |
| X | New Jersey | | X | X | have: empl. orient., & office occup. |
| | New Mexico | | | | X |
| X | New York | | X | | |
| X | North Carolina | | X | | |
| X | North Dakota | | X | | |
| X | Ohio | | X | X | confused as to answer |
| X | Oklahoma | | X | | |
| | Oregon | | | | |
| X | Pennsylvania | | X | | |
| X | Rhode Island | | X | | |
| X | South Carolina | | X | | |
| X | Tennessee | | X | | |
| X | Texas | | X | | |
| X | Washington | | X | | |
| X | West Virginia | | X | | |
| X | Wisconsin | | X | | |
| X | Wyoming | | X | | |
| X | Puerto Rico | | X | | |
| X | Alaska | | X | | |
| | Maryland | | | | |

Copy of letter sent to states, as shown on preceding page, asking if they had mobile units.

## M E M O R A N D U M

TO: All RCU Directors

FROM: John Stephens-Utah RCU

DATE: January 16, 1969

Please complete the form below and return as soon as possible.

______________________________ (does) (does not) have a mobile
(state) (strike one)
classroom which travels from school to school to provide training in electronics.

If yes, continue below:

The person most knowledgeable whom we could contact is:

______________________________
NAME

______________________________
TITLE

______________________________
ADDRESS

______________________________
CITY, STATE, ZIP

See you at the RCU Directors' Convention in March!

Letter sent to Mr. Lee Palmer and Mr. Marvis Seglem.

April 16, 1969

Dear Sir:

The College of Southern Utah has converted a surplus trailer into an electronic mobile training classroom. This unit is in its primary stages of operation since this is the first time that a unit of this type has been attempted in Utah.

I am a graduate student at Utah State University and will be studying and evaluating this unit and its program.

In doing a review of literature, I came across an article on your mobile electronics training unit in New Mexico. I am interested in getting as much information as possible about your unit and its programs and values. After seeing the pictures of the converted bus, I have come to the realization that this has many advantages over the trailer in time utilization for small schools. The trailer which we are using will stay six weeks at each school. As you can see, if it were a bus such as yours, it could possibly move twice a day to different schools for better utilization.

Any information which you have accumulated about this approach would be greatly appreciated. I realize that this type of unit is working effectively in other areas, and I feel it has potential in electronics.

Thank you for your cooperation.

Sincerely yours,

Grant W. Widmer

April 28, 1969

Mr. Grant W. Widmer
441 North 5 East
Logan, Utah 84321

Dear Mr. Widmer:

Thank you for your letter of April 16th. I think you have a worthwhile project for your graduate study assignment. Much can be developed in this area. We wish you success on this particular study.

We are sending a rough draft of an original proposal which was submitted on one of our initial mobile unit projects. This was a project which involved the State Department of Vocational Education, Educational Services, which is part of the Research Division, and the schools themselves.

This year, we have plans for two electronics mobile units; one has been approved and the other is pending. We plan to move the unit daily, operating on a half-day basis between two schools only. The proposal we have sent you recommends the use of the unit between three schools, and this became rather an overload, and the travel became excessive.

We are using Simpson Electronic equipment because of its flexibility and adapability to the use. Mr. Bill Allen, the Regional Representative now located in Albuquerque, has worked very closely with the State Department and others, including the schools in trying to make these programs prove successful.

If the mobile units prove worthwhile, we anticipate going into other occupational areas, pending the availability of funds.

Thank you for having the interest in vocational education. If we can further identify areas which might have value to you in completing your study, please contact us.

Sincerely,

LEE PALMER
State Supervisor
Trade & Industrial Education

(Enclosure)

May 16, 1969

Mr. Grant W. Widmer
441 North 5 East
Logan, Utah 84321

Dear Mr. Widmer:

Reference is made to your recent letter regarding the mobile classroom we are using at Parker and Salome High Schools.

This unit utilizes the Simpson-Rets teaching system and is designed for elementary electricity-electronics classes.

We plan to put on a second bus for industrial electronics-television repair for next year.

The #1 bus is and will be at each school for 1/2 day--every day and will enroll junior class students.

The #2 (advanced) bus will work an opposite schedule and will enroll senior class students.

May I suggest that the person best able to evaluate this would be Mr. Emmet Sims, Principal, Northern Yuma County High School District, P.O. Box A, Parker, Arizona 85344.

May I wish you success in your study.

Sincerely,

Marvin H. Seglem, State Supervisor
Trade and Industrial Education

MHS:ae

# APPENDIX B

## Measurement Materials

## Electricity - Electronics

## Examination

SCHOOL________________________________ GRADE LEVEL__________

NAME____________________________ ADDRESS____________________

____________________

PARENT OR GUARDIAN________________________ PHONE______________

The test you are about to take is an attempt to find out how much you know about electricity and electronics, whether you learned in school or some other place. Do your best. If you are not sure, you may choose to answer, but avoid wild guessing.

Directions: Each of the questions or incomplete statements listed below is followed by several words, phrases, or series of numbers. From these, you are to choose the one which answers the question or completes the statement correctly. Read them all before choosing. Then circle the number of the answer you have chosen.

1. An electrical fuse in the house "blows" because:

    1. it gets old
    2. the circuit is overloaded
    3. the wires are too short
    4. the transformer is the wrong size
    5. turning on the switch causes a current surge

2. Which of the following <u>is not</u> a part of an AC generator?

    1. slip ring
    2. field pole
    3. brush
    4. commutator
    5. excitor

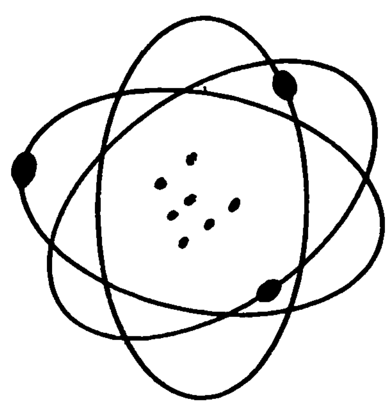
3. A teletype is part of a:

    1. communications system
    2. printing press
    3. typewriter
    4. tape recorder
    5. lie detector

4. The capacitor is an electrical device which has the ability to:

    1. make light
    2. store electrons
    3. cut down current flow
    4. send signals
    5. change direct current to alternating current

5. The drawing represents one atom of lithium. The particles shown in orbit are:



    1. electrons
    2. protons
    3. neutrons
    4. ions
    5. molecules

6. If a light bulb which is designed for use on 120 volts is connected to a 240-volt line, the bulb will:

    1. light with twice its normal light
    2. burn out
    3. light with half its normal light
    4. won't light at all
    5. just barely light

7. If a short wire is connected from the positive post of a battery to the negative post, the wire:

   1. explodes
   2. contracts
   3. gets hotter
   4. gets cooler
   5. forms an oxide

8. The electric starter in an automobile is really a small:

   1. generator
   2. motor
   3. electromagnet
   4. turbine
   5. transformer

9. Of the following, the best location for a hydro-electric plant would be:

   1. at the source of a high mountain stream
   2. in a broad river valley
   3. beside a large lake
   4. beside the ocean
   5. alongside a large waterfall

10. One type of Christmas tree lighting is made so that if one lamp burns out, the whole string goes out. This type of connection is known as:

    1. series
    2. shunt
    3. voltic
    4. parallel
    5. conventional

11. Which of the following metals can be magnetized permanently?

    1. aluminum
    2. silver
    3. tin
    4. zinc
    5. steel

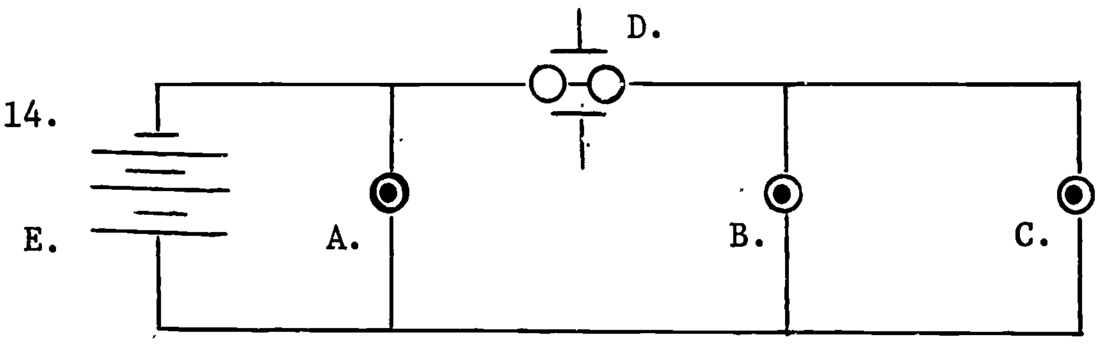
12. The south poles of two magnets will:

    1. attract each other
    2. first attract and then repel each other
    3. repel each other
    4. show neither attraction nor repulsion
    5. first repel each other and then attract

13. Which of the following is the best conductor of electricity?

1. rubber
2. nylon
3. carbon
4. iron
5. copper

14.




A, B, C, are lights
D is a push button
E is a battery

In the circuit shown, light A is turned on. What will be the result when push button D is operated?

1. light B will light
2. light C will light
3. nothing
4. lights B and C will light
5. light A will go out

15. Things through which an electric current <u>cannot</u> pass are called:

1. insulators
2. resistors
3. magnets
4. conductors
5. electrolytes

16. A generator has as one of its parts a:

1. resonator
2. carburetor
3. armature
4. piston rings
5. clutch

17. The north pole on one magnet and the south pole of another will:

1. show neither attraction nor repulsion
2. first attract each other and then repel
3. attract each other
4. first repel each other and then attract
5. repel each other

18. Which of the following move through a wire when an electric current flows through a wire?

    1. positive ions
    2. neutrons
    3. atoms
    4. electrons
    5. molecules

19. What happens when a magnet is cut into two pieces?

    1. the strength of the magnetism is increased
    2. the magnetism is destroyed
    3. each piece develops many weak poles
    4. each piece has one pole
    5. each piece has two poles

20. A coil of wire wound around an iron core describes an electrical device known as a:

    1. capacitor or condensor
    2. generator
    3. electromagnet
    4. heater
    5. resistor

21. A photo cell is:

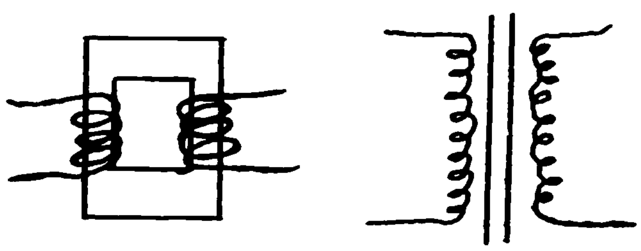
    1. a special kind of photographic battery
    2. a cell containing mercury
    3. a photographic box
    4. a photographic chemical
    5. a light sensitive device

22. Your voice is recorded on a tape recorder by which of the following efforts of an electric current?

    1. rotating
    2. storing
    3. magnetizing
    4. heating
    5. radio

23. These drawings represent:

    1. battery chargers
    2. spark coils
    3. electric motors
    4. transformers
    5. capacitors



24. Six dry cells in series will give a voltage:

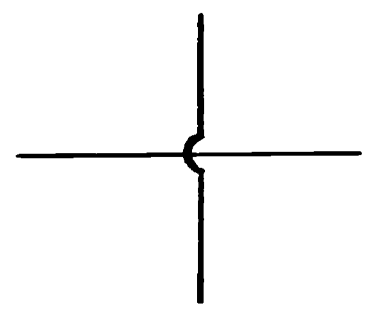
1. about the same as the one cell
2. six times that of one cell
3. one-sixth that of one cell
4. one-half that of one cell
5. twelve times that of one cell

25. The magnetic field around a wire carrying a current will effect the:

1. temperature of the air near the wire
2. direction of a compass needle held near the wire
3. strength of a direct current flowing in a near-by wire
4. strength of the wire
5. electrical conductivity of a piece of copper near the wire

26. The electrical symbol shown represents:

1. a door bell
2. crossed wires not connected
3. a TV antenna
4. crossed wires connected
5. a four-point switch



27. A transformer used for the operation of a doorbell has 300 turns in the primary and 30 turns in the secondary. The ratio of the voltage across the primary to the voltage across the secondary is:

1. 10:30
2. 3:1
3. 10:1
4. 30:1
5. 1:30

28. An electric motor changes electrical energy to mechanical energy. Which of the following effects of an electric current is responsible?

1. magnetic
2. heating
3. rotating
4. cooling
5. sparking

29. A transistor is a small:

1. radio
2. device that takes the place of a tube
3. relay
4. loud speaker
5. FM radio

30. The magnetic field in generators is produced by:

    1. transformers
    2. natural magnets
    3. electromagnets
    4. condensers
    5. Leyden jars

31. A type of electrical device that turns the street lights on when it gets dark and off when it gets light is called:

    1. a knife switch
    2. a photoelectric switch
    3. a rotary switch
    4. an astronomical switch
    5. a lamp lighter switch

32. In the television picture chain the first step is to change light energy into electrical energy. The last step is a change of electrical energy into:

    1. heat energy
    2. work energy
    3. light energy
    4. high voltage energy
    5. sound energy

33. If a lightning rod is to protect a building adequately, it is most important that the rod be:

    1. made to project at least ten feet above the lightest point of the building

    2. insulated from the rest of the building and from the ground
    3. made from a material of high resistance
    4. connected to ground by a conductor
    5. firmly embedded in the building wall

34. There are two wires in the power cord of electrical applicances because:

    1. if one breaks, the other can be used to carry the current
    2. two wires carry twice as much current
    3. using two wires prevents short circuits
    4. using two wires reduced the amount of electricity needed
    5. the current comes in on one and goes out on the other

35. Electrical resistance is measured in:

    1. mhos
    2. amperes
    3. volts
    4. watts
    5. ohms

36. A transformer is a device used for changing:

    1. alternating current to direct current
    2. direct current to alternating current
    3. voltage to current
    4. voltage up or down
    5. low frequency to high frequency

37. Current is carried to and from the commutator of an electric motor by:

    1. magnet poles
    2. inductors
    3. slip rings
    4. brushes
    5. switches

38. Which of the following is an example of the use of an ionized luminous gas?

    1. an x-ray
    2. a tungsten lamp
    3. a neon sign
    4. a diathermy machine
    5. an amplifier tube in a radio

39. The kind of wire used in toasters and soldering irons is made of a metal called:

    1. nichrome
    2. allogy
    3. iron
    4. aluminum
    5. brass

40. The electrical device made by twisting together two wires of different metals and heating the junction is known as a:

    1. resistor
    2. coil
    3. transformer
    4. microphone
    5. thermocouple

41. The term <u>short circuit</u> means most nearly a:

    1. connection between two points where ordinarily no connection is intended
    2. length of wire that has been cut too short
    3. load connected to a circuit for only short intervals
    4. light load connected to a circuit
    5. circuit with a small amount of wire connecting the parts

42. A commutator is a part of an electric:

    1. heater
    2. doorbell
    3. chimes
    4. motor
    5. radio

43. Earphones must be used instead of a loud speaker with a crystal set because:

    1. the power of a crystal set is not sufficient to operate a loud speaker
    2. a loud speaker needs higher frequencies than those made available by a crystal set
    3. a loud speaker works only on amplitude modulated outputs
    4. a crystal set fails to deliver the low frequencies which can be heard with a loud speaker
    5. earphones produce less noise than a loud speaker

44. The coil in an automobile electrical ignition system is used to:

    1. step up voltage
    2. hold back current
    3. change AC to DC
    4. make more current flow
    5. step down voltage

45. the long-distance transmission of electrical power would have been impossible except for the invention of:

    1. the electric motor
    2. radar
    3. the AC generator
    4. the betatron
    5. the accelerator

46. A workman made a mistake in connecting a push button at the back door of a house. It was found that in order to make the bell ring both front and back door, buttons must be pushed at the same time. The type of circuit accidently connected is called:

    1. series
    2. series-parallel
    3. parallel
    4. shunt
    5. three-way

47. The instrument in a television studio that picks up sound waves and changes them into electrical waves is called a:

    1. condenser
    2. oscilloscope
    3. crystal
    4. microphone
    5. photo electric cell

48. The unit of measurement of electrical power is the:

    1. volt
    2. ion
    3. ampere
    4. cycle
    5. watt

49. A magnet will lose some of its magnetism if it is:

    1. painted
    2. pointed toward the north pole of the earth
    3. held under water
    4. dropped
    5. brought near a piece of metal

50. A water solution which can carry an electric current is called:

    1. an anode
    2. a cathode
    3. a wet cell
    4. suspension
    5. an electrolyte

51. Dry cells last longer when used in a circuit which:

    1. is turned on only for short intervals
    2. is turned on for long intervals
    3. requires alternating current
    4. has a low resistance and is used continuously
    5. contains a step-up transformer

52. If the speed of an alternation current generator is increased, the effect will be to:

    1. increase the voltage and lower the current
    2. increase the frequency but not the voltage
    3. increase the current only
    4. increase the frequency and voltage
    5. increase the voltage but not the frequency

53. The north-seeking pole of a magnet and the north magnetic pole of the earth have what kinds of magnetic poles?

1. iron magnetism and earth magnetism
2. the same
3. entirely different kinds of magnetism
4. moving
5. the opposite

54. A resistor uses up electrical energy and changes it to:

1. power
2. voltage
3. heat
4. light
5. radio waves

55. Two conductors separated by a nonconductor describe an electric device known as a:

1. resistor
2. capacitor
3. heater
4. transformer
5. inductor

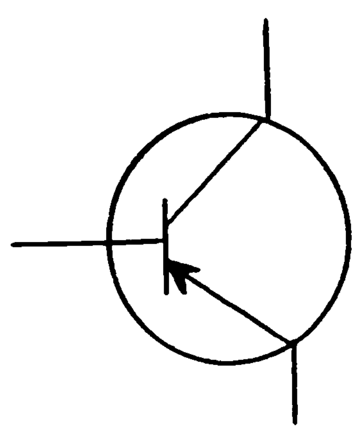
56. To change the direction of rotation of a series-type motor, it is necessary to:

1. reverse the current flow to either the armature or the field coils
2. reverse the brushes
3. change the commutator to slip rings
4. move the brushes $90^{\circ}$
5. reverse the plug

57. A radio uses a current of two amperes on a 120-volt line. How many watts does it use?

1. 30
2. 60
3. 120
4. 240
5. 746

58. The symbol represents a;



1. lamp bulb
2. transistor
3. transformer
4. telephone
5. voltmeter

59. Two scouts want to rig a light for a tent. A six-volt battery is available and two three-volt lamps. Without any more parts except wire, for best operation, the lamps should be connected in:

1. parallel with each other and the battery
2. parallel across one section of the battery
3. series with each other and the battery
4. series-parallel with each other and in series with the battery
5. parallel-series with each other and in parallel with the battery

60. In a telephone, the part you talk into and the part you listen to both contain a:

1. microphone
2. battery
3. permanent magnet
4. diaphram
5. transformer

61. A radio tuner can be constructed with a:

1. coil and condenser
2. resistor and a coil
3. transformer and a resistor
4. tube and resistor
5. transistor and a coil

62. A continuity meter is another name for:

1. a voltmeter
2. an ohmmeter
3. a wattmeter
4. a frequency meter
5. an ammeter

63. An ammeter is connected in <u>series</u> with a load. This is done because:

1. a parallel connection would require a low-resistance meter
2. the resistance of the meter is very high
3. a series connection prevents a voltage drop from forming across the meter
4. the meter would consume too much voltage if it were connected any other way
5. current is measured in amperes, representing the rate of flow past a given point in the circuit

64. When moving magnetic field is brought near a wire, a voltage is developed in the wire. This effect is known as:

1. resistance
2. capacitance
3. induction
4. conduction
5. reactance

65. Which of the following instruments is used to measure the strength of an electric current?

1. potentiometer
2. ammeter
3. field strength meter
4. wattmeter
5. electroscope

66. What would be the cost of operating one 200-watt lamp four hours per day for 30 days if the rate per kilowatt hour is $.05?

1. $ .80
2. $1.20
3. $2.00
4. $2.40
5. $6.00

67. A relay is an electrical device used to:

1. open or close a switch with an electromagnet
2. distribute electricity
3. change alternating current to high-voltage current
4. convert sound into voltage
5. blink the lights in an automobile turn signal

68. Frequency modulation is a means of:

1. brightening television pictures
2. transmitting radio programs
3. transmitting radar signals
4. transmitting sounds on a beam of light
5. bouncing signals from a satellite

69. One hundred twenty volts sends a current of 5 amperes through a circuit for 60 hours. The total wattage used is:

1. 120
2. 360
3. 720
4. 7,200
5. 36,000

70. The operation of the filament vacuum tube depends on the fact that a conductor emits electrons when:

1. placed in a glass tube
2. placed in a strong magnetic field
3. electroplated with copper
4. coated with carbon
5. heated

71. The device used in a flourescent lamp to limit the current is known as a:

    1. ballast
    2. starter
    3. transformer
    4. limiter
    5. insulator

72. What is the source of the electrical energy supplied by a dry cell?

    1. electrical energy which has been stored in the cell by charging it with a battery charger
    2. electrical energy which has been stored in the cell by charging it with static electricity
    3. magnetic energy
    4. chemical reactions
    5. the magnet field between the poles

73. The most powerful type of magnet is:

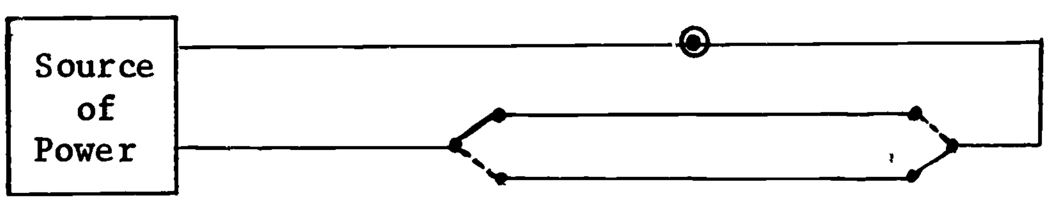
    1. a lodestone
    2. magnetite
    3. a horseshoe magnet
    4. a bar magnet
    5. an electromagnet

74. When resistors are connected in series the <u>total</u> resistance is:

    1. the equivalent of the smallest resistance
    2. the sum of the individual resistances
    3. the equivalent of the largest resistance value
    4. less than the value of the smallest resistance
    5. more than the sum of the individual resistance

75. The circuit shown represents which of the following?

    1. a four-way switch circuit
    2. a knife switch circuit
    3. a three-way switch circuit
    4. a motor circuit
    5. a reversing switch circuit




When you have finished, check your work. Make sure that there are no marks on the answer sheet except where you want them.

MAKE SURE YOUR STUDENT QUESTIONNAIRE IS COMPLETELY FILLED OUT.

SCHOOL________________________________________

NAME________________________ ADDRESS____________________

____________________

PARENT OR GUARDIAN________________________ PHONE__________

DIRECTIONS: Below are several statements about the period of instruction which you have just completed. Read each statement carefully and indicate the degree to which you agree or disagree with it according to the following scale:

SD - Strongly Disagree - I strongly disagree with the statement.

D - Disagree - I disagree with the statement, but not strongly so.

N - Neutral - I am neutral toward the statement or don't know enough about it.

A - Agree - I agree with the statement, but not strongly so.

SA - Strongly Agree - I strongly agree with the statement.

| CIRCLE YOUR RESPONSE | ..Strongly Disagree | ..Disagree | ..Neutral | ..Agree | ..Strongly Agree |
|---|---|---|---|---|---|
| 1. I would like more instruction presented in this way.......................................... | SD | D | N | A | SA |
| 2. I learned more because equipment was available for me to use.................................... | SD | D | N | A | SA |
| 3. This instruction was very boring................. | SD | D | N | A | SA |
| 4. The material presented was of much value to me... | SD | D | N | A | SA |
| 5. The instruction was too specific................. | SD | D | N | A | SA |
| 6. I was glad just to get through the material...... | SD | D | N | A | SA |
| 7. The material presented will help me to solve problems.......................................... | SD | D | N | A | SA |
| 8. While taking this instruction I almost felt as if someone was talking with me.................. | SD | D | N | A | SA |
| 9. I can apply very little of the material which I learned to a practical situation................. | SD | D | N | A | SA |
| 10. The material made me feel at ease............... | SD | D | N | A | SA |
| 11. In view of the time allowed for learning, I felt that too much material was presented............. | SD | D | N | A | SA |

| | ...Strongly Disagree | ...Disagree | ...Neutral | ...Agree | ...Strongly Agree |
|---|---|---|---|---|---|
| 12. I could pass an examination over the material which was presented................................ | SD | D | N | A | SA |
| 13. I was more involved with using equipment than with understanding the material.................. | SD | D | N | A | SA |
| 14. I became easily discouraged with this type of instruction......................................... | SD | D | N | A | SA |
| 15. I enjoy this type of instruction because I get to use my hands.................................. | SD | D | N | A | SA |
| 16. I was not sure how much I learned while taking this instruction.................................. | SD | D | N | A | SA |
| 17. There are too many distractions with this method of instruction.............................. | SD | D | N | A | SA |
| 18. The material which I learned will help me when I take more instruction in this area........ | SD | D | N | A | SA |
| 19. This instructional method did not seem to be any more valuable than regular classroom instruction. | SD | D | N | A | SA |
| 20. I felt that I want to do my best work while taking this instruction........................... | SD | D | N | A | SA |
| 21. This method of instruction makes learning too mechanical.......................................... | SD | D | N | A | SA |
| 22. The instruction has increased my ability to think.............................................. | SD | D | N | A | SA |
| 23. I had difficulty reading the written material that was used.................................... | SD | D | N | A | SA |
| 24. I felt frustrated by the instructional situation........................................ | SD | D | N | A | SA |
| 25. This is a poor way for me to learn skills........ | SD | D | N | A | SA |
| 26. This method of instruction does not seem to be any better than other methods of instruction..... | SD | D | N | A | SA |
| 27. I am interested in trying to find out more about the subject matter.............................. | SD | D | N | A | SA |
| 28. It was hard for me to follow the order of this instruction...................................... | SD | D | N | A | SA |

| | | ..Strongly Disagree | ..Disagree | ..Neutral | ..Agree | ..Strongly Agree |
|---|---|---|---|---|---|---|
| 29. | While taking this instruction I felt isolated and alone | SD | D | N | A | SA |
| 30. | I felt uncertain as to my performance in the instruction | SD | D | N | A | SA |
| 31. | There was enough time to learn the material that was presented | SD | D | N | A | SA |
| 32. | I don't like this instruction any better than other kinds I have had | SD | D | N | A | SA |
| 33. | The material presented was difficult to understand | SD | D | N | A | SA |
| 34. | This was a very good way to learn the material | SD | D | N | A | SA |
| 35. | I felt very uneasy while taking this instruction | SD | D | N | A | SA |
| 36. | The material presented seemed to fit in well with my previous knowledge of the subject | SD | D | N | A | SA |
| 37. | This method of instruction was a poor use of my time | SD | D | N | A | SA |
| 38. | While taking this instruction I felt challenged to do my best work | SD | D | N | A | SA |
| 39. | I dislike the way that I was instructed | SD | D | N | A | SA |
| 40. | The instruction gave me facts and not just talk | SD | D | N | A | SA |
| 41. | I guessed at most of the answers to problems | SD | D | N | A | SA |
| 42. | Answers were given to the questions that I had about the material | SD | D | N | A | SA |
| 43. | I seemed to learn very slowly with this type of instruction | SD | D | N | A | SA |
| 44. | This type of instruction makes me want to work harder | SD | D | N | A | SA |
| 45. | I did not understand the material that was presented | SD | D | N | A | SA |
| 46. | I felt as if I had my own teacher while taking this instruction | SD | D | N | A | SA |
| 47. | I felt that no one really cared whether I worked or not | SD | D | N | A | SA |

STUDENT QUESTIONNAIRE
FOR MOBILE ELECTRONICS PROGRAM

1. What do you plan to do for your life's work?

2. How were you selected for this program?

3. Has this program stimulated your interest in the field of electronics?

   Yes________

   No_________

4. Would a longer stay with the unit at your school be advantageous over the period which you had?

   Yes________

   No_________

   If yes, how long do you recommend?__________________________________

5. Do you think the mobile electronics program coming into your school once a year for a short period will give you the opportunities you want in electronics?

   Yes________

   No_________

6. Did you miss another class in order to participate in this electronics program?

   Yes________

   No_________

   If yes, did you have any difficulty in making up the work which you missed?

   Yes________

   No_________

7. Any comments or opinions which you have concerning this program will be very helpful to us. Please write them here.